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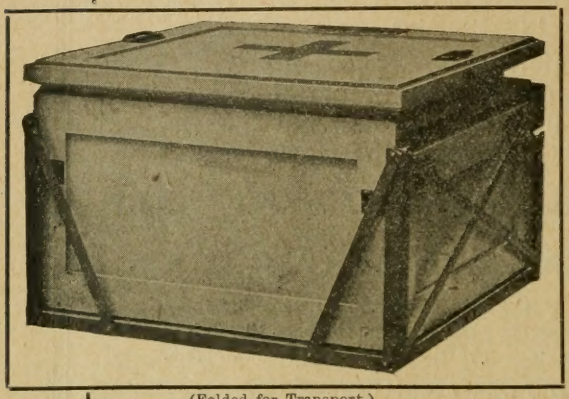

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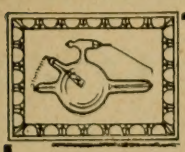

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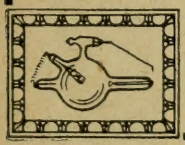

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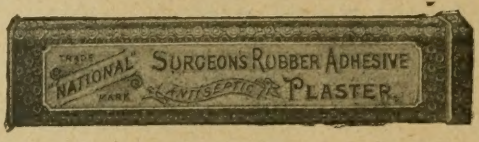

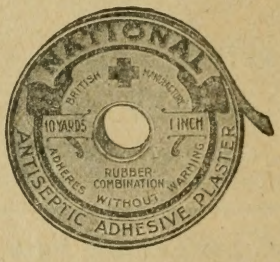

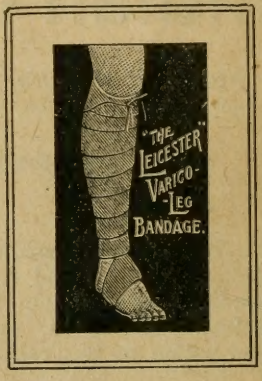

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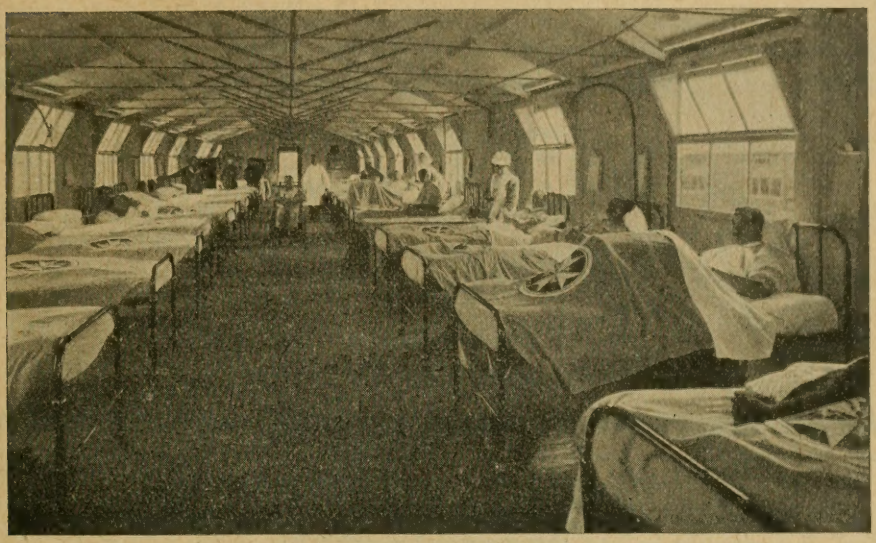

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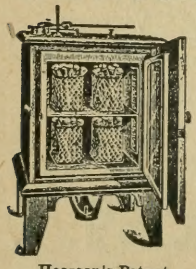

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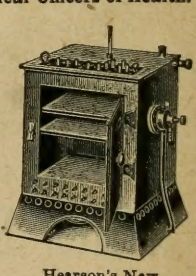

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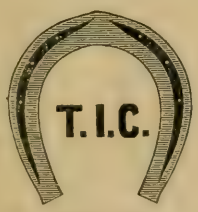

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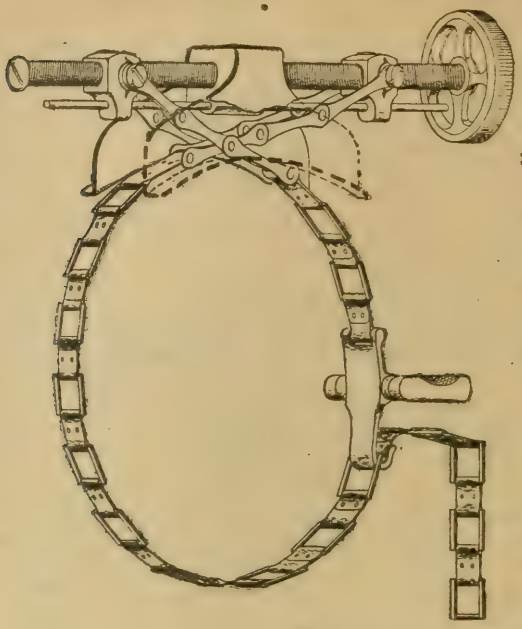

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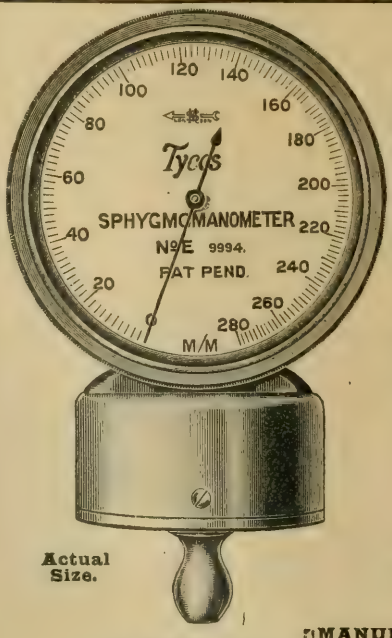

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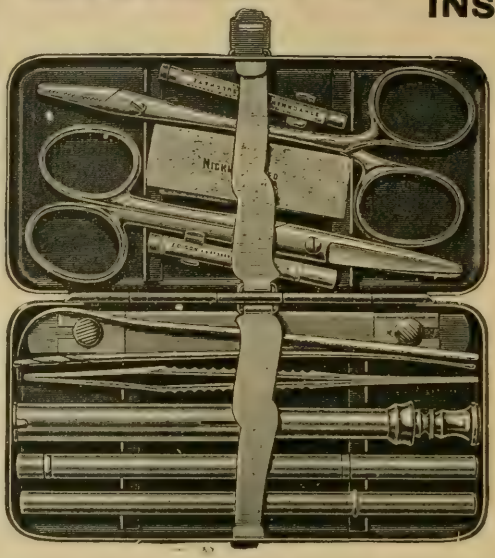

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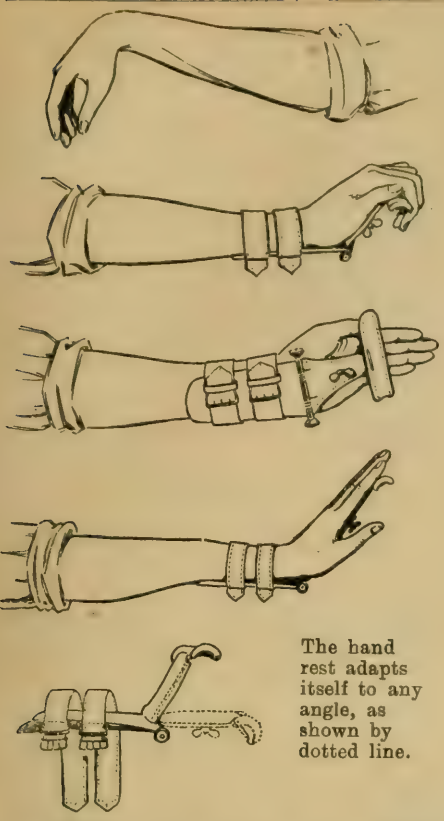

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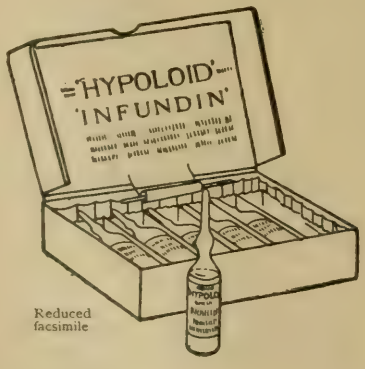

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Royal Army Medical Corps.

Original Communications.

PHYSIOLOGICAL EFFECTS OF A PROLONGED REDUCTION IN DIET ON TWENTY-FIVE MEN.[1]

BY FRANCIS G. BENEDICT.

From the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Massachusetts.

IT is perhaps remarkable that with all the current discussion regarding food conservation, so little emphasis has been laid upon the possibility of conserving food by reducing the diet. When one recalls the agitation of enthusiasts for reduced diets during the past thirty years and recognizes the fact that all special pet theories can, at this psychological moment, obtain a better hearing than at any previous time, it is surprising that the advocates of reduced diet have made so little progress and, indeed, have apparently ceased their propaganda.

The popular conception that we eat too much is usually quantitatively expressed by the statement that we eat "twice as much as we ought." The Nutrition Laboratory has for years been endeavouring to discover if there exist any special groups of individuals who live regularly upon a diet that would be commensurately low. For this purpose it was assumed that the minimum or basal metabolism must be taken as the index of food requirement. Differences in muscular activity are so great that no two individuals can be compared save on an absolute quiescent, resting basis. After the metabolism of 200 or more individuals had been carefully measured, it was seen that, although we were dealing with people of varying ages, dietetic habits, and supposedly very low metabolism, no such individuals were easily recognized in our measurements. It would thus appear off hand, that if there are no individuals other than pathological

[1] Address given to the American Philosophical Society April 20, 1918.

which present abnormally low basal metabolism and if the law of conservation of energy in the human body obtains, as we know it does, then there is no *a priori* reason for expecting that a reduced diet can be permanently adhered to. A reduction in diet will simply mean that body reserves will be drawn upon until death from starvation occurs.

About a year ago I had the privilege of meeting Professor Alonzo E. Taylor in Philadelphia, when I received at first hand information regarding some of his important observations in Germany on the dietetic habits of the German civilian population. While there was no quantitative measurement of the food intake of these people, the fact appeared to be established without doubt that the Germans were subsisting upon a very low calorie intake and that this had endured for so long a time since the beginning of the war that it seemed highly probable that the former liberal body reserves no longer supplemented the diet. As a result of this conference a previously-formed plan was crystallized into definite action. After conference with my colleagues at the Nutrition Laboratory, an extensive research upon the influence of a prolonged reduction in diet on a group of men was outlined. Obviously much profit was derived from the criticisms of the historic research of Professor Chittenden with his group of soldiers. Professor Chittenden's problem dealt mainly with the nitrogen intake and output, but when the energy of the diet comes into discussion, it is clear that the dietetic control must be even more rigid and one must, in the last analysis, be wholly dependent upon the personal integrity and veracity of the subjects. If a person ate more protein than was allowed, this would show in the urine. A person could eat considerably more calories than actually allowed and yet no direct chemical control could be secured.

Through the kind offices of Professors J. H. McCurdy and Elmer Berry, of the International Y.M.C.A. College at Springfield, Massachusetts, both unusually interested in metabolism problems, arrangements were made to select twelve men out of a group of volunteers from the student body. The men entered heartily into the spirit of the whole research, and readily consented to all the strict requirements of the test.

It is a great pleasure to record that during the four months of experimenting there was not the slightest indication of any of these men wittingly or unwittingly violating even the strictest regulations of the research. The honour system obtains at the College; the men realized that they were in a position to do the nation a great service, and with the fidelity, enthusiasm, and high ethical spirit exhibited by the whole student body, these men went through the arduous four months without a serious complaint.

The general plan was to curtail the diet sufficiently to reduce the weight approximately ten per cent. This could have been done by a complete withdrawal of food for about fourteen or fifteen days. It was recognized that these men were, first, college students with obligations for educational advancement, and, second, volunteers for scientific research. A complete

fast for fourteen days would, in all probability, have caused most of them considerable discomfort, if not distress. The alternative was to curtail the dietetic intake so that the weight loss would take place, not in fourteen days but in four to six weeks. This was done by serving the men approximately one-half to two-thirds of the caloric requirements prior to the dietetic control, making absolutely no change in the kinds of foods eaten. The young men were cautioned not to lessen their mental or physical activities. Obviously if the activity of a group of men were lessened as, for instance, by putting them to bed, to use an extreme illustration, their dietetic requirements would be very much less. Suffice it to say that these men carried out all the requirements of collegiate activity, both physical and intellectual, throughout the entire period. As soon as the reduction in weight had reached ten per cent or thereabouts, the calories in the intake were increased to such an extent as to hold the weight at a constant level. The number of calories required to hold this weight constant over a considerable period of time could be taken as a fair representation of the actual caloric requirement for this group of men.

At the start we were confronted with the possibility of a seasonal variation. Thus, if one took a group of twelve active Y.M.C.A. students, at the end of a summer vacation, fresh from summer camps with their outdoor activities, and placed them in academic halls with restricted hours, artificial illumination and curtailed physical activity, it is conceivable that there would be a normal retardation of metabolism in the later fall months.

To insure a suitable base line, therefore, a second group of twelve men from the large number of volunteers originally presenting themselves were selected to act as a control squad. These men were in every particular studied with the same degree of care as Squad No. 1, except that there was no dietetic control.

While body-weight can be taken as an approximate index of the metabolic level, further checks were absolutely necessary to rule out the inevitable differences in muscular activity that would be found with groups of individuals, even when they were subsisting under the same collegiate conditions. The gaseous metabolism was therefore measured practically every morning for each one of the first squad. These measurements were made by collecting the expired air and analysing it. From the amounts of oxygen consumed and carbon dioxide produced, the basal heat output could be computed by indirect calorimetry, thus furnishing the second index of metabolic level. The pulse-rate was recorded simultaneously every morning. Every other Saturday night the entire group of men were taken to Boston and placed inside a large respiration chamber, where they could sleep comfortably. The carbon-dioxide excretion of the twelve men was thus determined simultaneously during deep sleep. This furnished a third criterion for judging the metabolic level.

The control squad showed no seasonal variation and their basal metabolism, as measured in the large respiration chamber in Boston, was

found to be absolutely identical with that of the first group of twelve men prior to the restriction in diet. To check the important findings with the first squad during the early period of the investigation, the second squad was later placed upon a very restricted diet for a period of three weeks, the diet given being less than one-half of their normal requirements.

For both squads, when on diet, the food for each day was carefully weighed, sampled, and analysed for the individual men. It is thus possible for us to measure the complete intake of protein and calories. The urine was collected throughout the entire time, and the fæces at frequent intervals. It is a tribute to the painstaking and conscientious co-operation of these men that throughout the entire period of four months, the urine was rarely lost. We thus have complete data for striking a balance between the nitrogen in the food and the nitrogen in urine and fæces.

Advantage was taken of each bi-weekly visit of the separate squads to the laboratory in Boston to put them through seventeen psycho-physiological tests. Although it was rather difficult to secure much evidence of introspection without the danger of suggestion, careful records of all the relevant observations on introspection were made.

The most important scientific findings may be summed up as follows :—

(1) A gradual reduction in weight to a point twelve per cent below the initial weight took place during a period of from three to ten weeks, with low calories and a moderate amount of protein in the food intake. The normal demand of the men prior to the dietetic alteration ranged from 3,200 to 3,600 net calories. One squad of twelve men subsisted for three weeks on 1,400 net calories without special disturbance.

(2) After the loss in weight of twelve per cent had been reached, the net calories required to maintain this weight averaged about 2,300,[1] or approximately one-third less than the original amount required.

(3) At the end of the reduction in weight, the actual heat output during the hours of sleep, as computed by indirect calorimetry, was approximately one-fourth less than normal, thus giving a rough confirmation of the lowered number of calories found by actual measurement of the food intake. That there was no seasonal variation in metabolism was shown by the constancy in the metabolic level of the control squad.

(4) The heat output by indirect calorimetry per kilogram of body weight and per square metre of body surface was essentially eighteen per cent lower than at the beginning of the study.

(5) Throughout the period of loss in weight and for some time subsequent thereto, there was a marked loss of nitrogen to the body. In round numbers these men each lost approximately 150 grammes of nitrogen. There is an intimate relationship between this "surplus nitrogen" and the metabolic level. Removing the "surplus nitrogen," we believe, distinctly lowers the stimulus to cellular activity.

[1] Subsequent revision has shown that the net calories required, averaged 1,950 rather than 2,300.

(6) The nitrogen output per day at the maintenance diet of 2,300 net calories was about 10·5 grammes. The control group of twelve men, living substantially the same life and eating in the same dining-room, but with unrestricted diet, showed a nitrogen output of fourteen grammes per day.

(7) The pulse rate was astonishingly lowered. Many of the men showed morning pulse rates as low as 33, and daily counts of 32, 31 and 30 were obtained ; at least one subject gave six definite counts on one morning of 29.

(8) The blood pressure, both systolic and diastolic, was distinctly lowered.

(9) The skin temperature, as measured on the surface of the hands and forehead, was, with some subjects, considerably lower than normal. With most of the men normal temperatures prevailed.

(10) The rectal temperature was practically normal.

My colleague, Dr. Walter R. Miles, found as a result of numerous tests of the neuro-muscular processes that there was no material change as a result of the reduced diet. There was a very slight falling off in the strength tests with the hand dynamometer.

As one of the best indices of muscular performance my associate, Dr. H. Monmouth Smith, measured the energy required by each man to walk one mile in about twenty minutes. With a reduced diet, the requirement was found to be lower with all the men than with a normal diet, this being due, in part, to the fact that the reduced weight meant a lower weight to transport. In other words, these men walked a mile with noticeably less energy consumption than a man not subsisting on a reduced diet.

The subjective impressions were almost uniform that the muscles in the thigh were distinctly weakened. The men complained of difficulty in walking upstairs, but our personal observations go a long way towards refuting this, for all the men seemed able to go upstairs two steps at a jump on several occasions. On February 1, 1918, at Springfield, after four months on diet, eleven of the diet squad were pitted against eleven men from the College body in an arm-holding contest for endurance. The arms were held extended, palms down, at the level of the shoulder. The number of men falling out were practically the same in both squads ; as a matter of fact, seven in the diet squad and eight in the uncontrolled squad held their arms out for one full hour.

Two of the men had chronic bad noses. One was operated upon during the test and the other should have been. Aside from these two, the prevalence of colds during the period was about the same as with the other college students. During the study three men underwent ether narcosis for operations (on nose, foot and hæmorrhoids) and made rapid recoveries. One man at the lowest period of weight became infected with typhoid, ran through a course of very high fever, and was critically ill for some time ; he has made a complete convalescence and recovery and has returned to college.

The most noticeable discomfort experienced by the subjects was a feeling of cold, which it is only fair to say might be due in large part to the severity

of the past winter. In general, notwithstanding the very great reduction in the metabolism, which we believe was due to the removal from the body of the stimulus to cellular activity of approximately 150 grammes of "surplus nitrogen," the whole period of lowered food intake had no untoward effect upon the physical or mental activities, and the men were able to continue successfully their college duties.

When the second squad was put upon a restricted diet, the picture exhibited by the first squad was strikingly duplicated in all details, although, as the loss in weight was obviously not so great with the second squad (six per cent as compared with twelve per cent), the phenomena were quantitatively somewhat less emphasized.

At the conclusion of the entire research the men presented an appearance not unlike the average college student; it would have been difficult to pick them out from the rest of the college body on the campus. On close inspection the members of the diet squad would perhaps have appeared somewhat emaciated, particularly in the face, but they were performing their duties as college students, both physically and intellectually, with no obvious reduction in stamina. No words can express their exact condition at the end of these tests so clearly as a short section of motion picture film, showing the general agility, spirit and physical ability of these men.

The great objection to making practical deductions from laboratory experiments is usually that such researches are carried out on the lower animals, or if men are studied but one or at the most two men are used. With a group of twenty-five men, such as was studied in this research, one is justified, if ever, in drawing deductions or making recommendations.

In addition to the fact that we have experimental evidence based upon twenty-five men from which to draw conclusions, we have also the fact that this is a period of stress, a period of innovation, a period for trial, for experimentation, for "taking chances," if you will. These combined factors are based, first, upon the large human experience of enforced diet restriction in Germany; second, upon the psychological set of the patriot; and, third, upon the moral obligation laid upon us all to contribute to the vast project of food conservation.

We cannot, then, be charged with faddism or irrational propaganda if we are led to make certain definite recommendations—recommendations that admittedly we would never make in peace times and that admittedly may have serious faults. These recommendations are primarily a war measure. In time of peace and plenty, the physician would rightly caution against an undue adjustment of the diet or fundamental alteration in dietetic habits. Still, when millions of our allies and hundreds of thousands of our own people are jeopardizing their very existence, it is not the time to talk about the possible dangers of moderate or even considerate changes in diet. With a large number of individuals, it may be of real psychological benefit to realize that they may, by personal diet restrictions, introduce an element of hazard into their lives, slight though it may be. No one could

look at those vigorous young men, carrying out their college work, examinations and physical activities in competition with their classmates, and not be impressed by the fact that the danger, if any exist, must be extremely remote.

As an index to the rather remote probability of danger, one should be reminded that the modern treatment of severe diabetes is essentially founded upon a lowering of the basal metabolism. Dr. Allen's diabetics, practically wrested from the jaws of death, present a remarkable picture. The curtailment in diet, with the low stimulus to cellular activity, has certainly in their case been a life-saving benefit.

A research of this kind offers almost unlimited field for speculation not only in pure physiology but likewise in its practical applications to everyday life. We believe it was made with a sufficient number of men to rule out the personal equation. Indeed, the individual picture presented by each man is strikingly uniform with the general picture presented of the group. There are no exceptions.

I find myself in a novel situation as a public advocate of far-reaching dietetic alterations. Recalling my earlier objections to Professor Chittenden's inferences from his experiments, I realize that, although abstract science and propaganda are more or less incompatible, in time of stress old beliefs may well be challenged, earlier concepts discarded, and conservatism permitted to exercise a less restraining influence; hence a public avowal of change of point of view and an admission of the errors of earlier judgment are not only desirable but absolutely necessary. While still maintaining that the published records of Professor Chittenden's experiments left the desirability of a propaganda for lower protein and energy open to serious fundamental criticism, I am now convinced that his data on protein intake justified many of his public statements and recommendations. His conjectures regarding caloric needs seem in no small part substantiated by the results of this new research.

Although some of our men were under 21 years of age, the data obtained in our experiments have no bearing on the period of growth; the diet of the growing child should under no circumstances be reduced. Neither are the results applicable to the conditions of severe muscular work as, for example, in the Army. They may, however, legitimately suggest practices for patriotic civilians not performing severe muscular work; that these standards represent the optimum needs for peace times requires further evidence for substantiation. It is quite clear that a civilian body of men could readily withstand a siege on half rations without difficulty for several months, and since danger seems remote, that reduced rations for all adult civilians may be justifiable as a war measure for a relatively long period of months. Professor Chittenden's conclusions from his experiments that a low-protein diet is practicable seem fully substantiated; this expensive source of food material may thus be materially lowered. The calories may also, without doubt, be lowered. Indeed, it may become a serious question

as to whether a patriot should be permitted in times of stress to carry excess body-weight, for the expense of carrying it around calls for calories that other people need. The excess weight is *prima facie* evidence that he is living at the highest metabolic level, higher than he needs by approximately twenty-five per cent, and there is no doubt that the excess weight contributes to shorten life.

Certain practical points in connexion with a reduction in diet are important. Difficulties in the shape of tendency to constipation can be easily controlled by the use of bran, as was done in our study. Bran also provides a certain amount of bulk which helps materially in producing a feeling of satiety. It is quite clear that variation in diet is absolutely essential. If a person craves a certain article of food, he may eat it, but stick religiously to the "half portion." The presence of an unlimited food supply on the table makes self-denial harder.

Of special significance is the importance of not eating between meals and of omitting the eating of extras. It has surprised us to find how large a proportion of the total diet is made up of these extras. Captain Gephart, in his study of the food intake of St. Paul's School, Concord, New Hampshire, found that out of a total daily intake of 5,000 calories per boy, 647 calories were derived from extras in the form of sweet chocolate, candy, coffee, buns, &c. With our control squad at Springfield when on normal diet, approximately 4,000 calories were consumed daily by each individual. Of this amount about 400 calories were obtained from extras not served at the table.

This is no time for the epicure. Every person should be under rather than over weight, and it should be popular not to be fat. To-day every woman as well as man should make it a special mission to see to the physical condition and not carry around excess fat or live upon an abnormally high metabolic level. By this means a great saving of food in this country can be effected to the positive advantage of health. It is more than probable that with reduction in flesh, the physical appearance will be somewhat less satisfactory, for admittedly the face may appear somewhat drawn. On the other hand, it is absolutely proved that excess weight is distinctly disadvantageous to health. People who are over weight are notoriously bad insurance risks. Even those overweights without demonstrated organic change in early or middle life show very high death-rates. Nobody should be over weight; most people should be somewhat under rather than over weight. If, when the war is ended, plenty is established and the need for restriction is removed, one wishes to go back to the former metabolic level, the way is very clear. The palate will lead to this way very readily. The purse may permit indulgence but the health may really be better for a moderate reduction.

We, who are far from the misery, trials and torments of the battlefield, are asked to restrict our diet intake, not only qualitatively (which Mr. Hoover and his associates have so wisely educated us to do), but quan-

titatively. It has been a fact, and a noticeable fact, that our most intelligent and best American men and women have been eager and anxious to do all they could, even at this distance, for the sake of the great cause. In this land of plenty it is highly improbable that positive measures calling for actual calorie restrictions will have to be passed, although this is by no means an impossibility. Here, as with all conservation measures, the volunteer is the first to take action. Let no one (particularly if he be over weight) complacently say that he has done his share until some positive action for food restriction has been taken. Fortunately no special chemical analyses, no calorimetric devices, no physiological measurements, are essential for the control of this factor. One has but to lower the body weight gradually ten per cent and adjust the food eaten to hold it at this level. The reduction in weight should cover a period of probably two to three months. It could be done in a considerably shorter time. When the weight is once lowered, and the calorie intake adjusted to holding the weight at that level, the patriot may feel assured that he or she is really making some positive contribution toward food conservation, and making it possible to send liberally to our Allies and to our own men much-needed supplies.

I cannot feel that an alteration in the Army diet is justifiable at present. It is bad policy "to swap horses in the middle of the stream." The fighting unit may well be exempted from innovations, but let the civilian population give this whole project a thorough, honest test, recognizing that while there may be, in certain cases, an element of hazard and in many cases an element of discomfort, the possibilities for danger in accomplishing a weight reduction of ten per cent are negligible. The calories thereby saved are by no means negligible, but with the sum total of our population would feed an enormous army.

TWO YEARS OF WAR SURGERY IN MALTA AND THE MEDITERRANEAN.

By Colonel WILLIAM THORBURN, C.B.
Consulting Surgeon Malta and Salonika Commands.

The surgical experiences of the present War have varied so widely in different areas and at different times that it is difficult to obtain any complete view of the problems which have been presented from time to time and from place to place and, as the conditions of work in Malta were in some respects very different from those in France and elsewhere, it has appeared to me that it may be useful to summarize the impressions gained and the lessons learnt in the Mediterranean from August 1, 1915, to the middle of September, 1917. During this period, except for occasional visits to Mudros and Suvla and excepting for the winter of 1915-16, which I spent at Salonika, I was fully occupied as a consulting surgeon in the Base Hospitals of Malta to which my remarks will refer almost entirely, while the following summary is intended not so much as a contribution to surgery as to surgical history.

In order to appreciate the nature of our work it may be useful briefly to call attention to the climatic conditions of Malta as well as to the nature of the hospitals, which were very differently evolved and administered from those of England and France. During the summer months the temperature is high and the heat is somewhat severely felt by northern Europeans. Although the thermometer in the shade rarely if ever reaches 100° and is more commonly between 80° and 90°, the air is extremely damp, especially during the prevalence of the "shirok" wind, and it is at least uncomfortable to work or to be out of doors during the hottest part of the day, the discomfort being increased by the almost entire absence of shade. During the winter months on the other hand the climate can only be described as mild, but it is very rainy and damp, while the construction of the buildings and the absence of heating arrangements make the evenings feel decidedly cold. The most noticeable feature of the climate is, however, undoubtedly its dampness, which intensifies all variations of temperature and more especially makes the hot summer nights very oppressive. These discomforts are increased by the prevalence of mosquitoes and especially of sandflies, those who are not acclimatized suffering a good deal from their bites, while "sandfly fever" is not uncommon. The drainage and other sanitary arrangements are good and the water supply fairly satisfactory but all the water used for drinking has to be boiled or otherwise sterilized. Fruit and vegetables cannot be safely eaten unless skinned or cooked as they are liable to be infected with dysentery. Malta fever or *melitensis* as the inhabitants naturally prefer to call it, is now practically unknown among

the British, who use only tinned milk, but it is still endemic among the civil population.

In spite of the quite definite discomforts referred to, the island cannot be called unhealthy, and we had no great amount of trouble with endemic diseases except in the case of dysentery, which could be avoided by care in dieting and by protecting food from flies. Malaria does not appear to exist as an endemic, and such infections as cholera, plague and the other dangers of the Near East are only rare and occasional visitors. Typhoid and paratyphoid fevers were met with from time to time, but were under full control, and certainly could not be regarded as affecting the choice of Malta as a hospital base. It may however be of some importance to those at home dealing with men who have been in the island to remember that we had a few cases of kala-azar.

The mildness of the climate was of considerable advantage in so far as it allowed many of the wounded to be treated in the open air, and balconies could be freely used for this purpose, while we were able to occupy buildings which in a more northern climate would hardly have been warm enough or sufficiently weather-proof. In such respects Malta is distinctly a favourable place for surgical cases; on the other hand, although immediate operation results were as good as in England, the enervating nature of the climate was apt to prolong ultimate convalescence and there is a sad lack of the general moral and hygienic effects summed up under the expression "change of air."

In peace time and during the first nine months of the War the military hospital accommodation of Malta was limited to the needs of the garrison, and excluding the naval hospital at Bighi, consisted of about 300 beds. In September, 1914, the already depleted regular staff was reinforced by the addition of a London Field Ambulance under the command of Colonel Sleman, but it was not until the commencement of the operations in the Dardanelles in April, 1915, that it became clear that a very great extension of accommodation and staff would be required. This accommodation had to be built up from local resources and by the dispatch from England of individual medical officers, no intact units ever having been sent to Malta except for short visits on their route to the East. With the building up of this organization the writer had little to do, and in all essentials it was completed on his arrival in the island.

In the spring of 1915 there were available for hospital purposes the original station hospital Cottonera, the old and often condemned Valetta Hospital of the Knights of St. John, various large and fairly modern barracks, and certain civil buildings such as schools and a few of the old Auberges. To these were added camps and some huts and in August of 1915 we had accommodation for 7,044 patients. The actual number of available beds has however since varied greatly; in March, 1916, when the needs of the Gallipoli campaign had been met, it amounted to 13,500, and was reduced to 12,000; in October, 1916, owing to the demands of the

Salonika force the highest figures were reached and we had 25,570 beds and 20,994 patients, but hereafter the numbers began to fall until when I left Malta there remained only 5,943 patients many of whom were convalescent. To the end of August, 1917, the total number of men treated in Malta was about 125,000, and of these approximately equal numbers came from Gallipoli and from Salonika, the great majority of serious surgical cases being in the former category.

The hospitals themselves, of which there were at one time 24, were variously located and varied also in the extent of their accommodation, but in August, 1915, the station hospital of Cottonera had 374 beds and that of Valetta 400 beds; 685 beds were in civil buildings such as schools and auberges; 3,589 were in stone-built barracks: and 1,996 were under canvas. The great majority of these hospitals were provided with operating theatres and as far as possible surgical cases were kept in stone buildings or transferred thereto for operation. An X-ray apparatus was provided in all the more important buildings. Most of the laboratory work was carried on in centralized laboratories, but the important surgical hospitals of Cottonera and Tigne and the isolation hospital of Imtarfa had each their own fully equipped pathological departments. Some difficulty occurred from the delay in obtaining medical stores from England, but by comparison with other bases I think we suffered extraordinarily little in this way and the greatest help was given to us by the officers of the Ordnance Department, who made not only nearly all our splints, but even surgical instruments of complicated pattern.

The staff of medical officers, consisting in the first instance of some half a dozen of the R.A.M.C., with the London Field Ambulance, was increased by the addition of medical officers of the local militia and by that of civil practitioners, as well as by drafts from England and a certain number of those returning from Serbia or going to Egypt. In the autumn of 1916 we also obtained the services of about 100 medical women, who carried out all but administrative duties and whose assistance cannot be too highly appreciated. The majority of the hospitals were under the command of territorial or temporarily commissioned officers, and practically all the divisional officers and medical and surgical specialists held temporary commissions; in spite of this no serious difficulty was found in connexion with the administration, but the small size of the whole command allowed of constant supervision by the successive Directors of Medical Services, Colonel Sleman and, after my arrival, Surgeon-Generals Sir Hayward Whitehead and Sir Thomas Yarr. Much of the smooth working of the whole command was also due to Lieutenant-Colonel Cumming, who was stationed in Malta before the War and who remained until the work had greatly diminished. The controlling figure throughout was however the Governor, Field-Marshal Lord Methuen, whose personal magnetism, deep sympathy and extraordinary interest in and knowledge of medical matters, combined with almost unlimited authority, smoothed away difficulties,

overcame the resistance of regulations little adapted to the peculiar conditions, and probably alone made possible the harmonious working of so many diverse elements.

The consulting physicians[1] and surgeons[2] carried out their duties much as in private practice at home, and were less of the nature of inspecting or liaison officers than they are in France.

After the early days of the Gallipoli campaign the surgeons performed personally nearly all the more serious operations, and we had the advantage, not obtained in most military areas, of being able, and indeed obliged, to retain our cases for considerable periods and thus to observe results. New methods of treatment could not be taken up quite so quickly as in stations nearer home and new drugs and apparatus were not so readily available, but there was probably a correspondingly less tendency to adopt such new methods on slight evidence, and a somewhat more critical attitude towards novelties. In addition to consulting and operating, a good deal of time was occupied in instructional work and occasional courses of lectures appeared to be regarded as of value by medical officers of limited experience. During the winter months a fortnightly "conference" gave a valuable opportunity for the interchange of ideas, and as nearly every branch of medicine was represented by some specially qualified practitioner, these meetings were of the greatest value to all of us.

Having said so much as to the general conditions of work in Malta, we may also note that the nature of the cases which we received for treatment varied much during two years, and may be roughly considered as falling into three periods or phases. (1) From the spring of 1915 to the end of that year the vast majority of patients were from Gallipoli; the conditions of the campaign on the peninsula called for rapid evacuation, and allowed of very little surgical aid before arrival in Malta, while a voyage of several days had to be endured by even the most gravely injured; under such conditions wounds arrived in an advanced stage of sepsis, and we were at times almost overwhelmed with cases of the most serious nature. Towards the end of the "Gallipoli period" disease became more prominent than wounds, and in the closing months, except for a group of cases of frostbite, the surgical casualties were not in excessive numbers. The last of the Gallipoli patients were evacuated in the spring of 1916. (2) The Salonika Expeditionary Force did not begin to send many sick to Malta until the end of 1916, and owing to the existence of efficient base hospitals in Salonika itself, the surgical cases never arrived in so acute or so serious a condition as those received from Gallipoli. On the other hand, the summer of 1916 provided a large number of "medical" casualties, and among these were many requiring surgical treatment for sequelæ or for intercurrent affections. (3) After the autumn of 1916, for various reasons to which no

[1] Colonels Purves Stewart, Gulland, Garrod, Tooth.

[2] Colonels Ballance, Charters Symonds, and the writer.

reference need here be made, the stream of work from Salonika also gradually diminished, and finally during the summer of 1917 surgery became largely such as is incidental to the considerable population constituted by the garrison, by convalescents, by passing transports, and the like.

Having thus dealt with the general situation in Malta, we may now turn to the consideration of the surgical work there, it being clearly understood that in the following notes I can give only my personal experiences and impressions, and that these in no way represent the views of any of my colleagues, who may or may not agree with my conclusions.

Aseptic operations were carried out as readily and with results as satisfactory as in England, but a few special precautions had to be observed. The heat of the operating rooms caused free perspiration on the part of both patient and staff, and care had to be taken to avoid soiling the wounds from this source. As the wearing of a mask covering the whole face was to me at any rate very exhausting in hot weather, I dispensed with these and preferred to wear a skull cap, having a piece of cotton wool tucked in under the forehead so as to absorb the perspiration. For such operations, however, as the removal of semilunar cartilages, I employed the mask which I prefer at home, and which consists of a skeleton pair of spectacle frames having no upper rim in the place which the lens would occupy; over this is hung a piece of gauze folded eight times, broad enough to cover the whole lower face and long enough to fall well down into the apron, which holds the gauze completely over the nose and mouth; by this device, introduced some years ago by my late house surgeon, Colonel Webb-Johnson, the breath is completely filtered or deflected well to the sides, and is not, as with many half masks, either deflected down on to the wound or allowed to escape from the uncovered nose. In the hottest season it was found comfortable to strip completely before operating, putting on merely a cotton suit of a jacket and a pair of trousers. The provision of rubber gloves presented some difficulty, as they were very liable to perish rapidly, but it was found that they could best be kept in good condition in an ice chest.

The preparation of the *patients' skin* also required some care, as it was apt to be very moist and not rarely to present inflamed insect bites. I was never quite satisfied with alcoholic iodine as a disinfectant, and I much preferred to clean the part with turpentine, followed by a 1 in 500 alcoholic solution of biniodide of mercury; the skin was then finally dried with ether and alcoholic iodine was painted over it. Small suppurating foci were often touched with the Pacquelin cautery before the operation was commenced; gauze was attached by clips round the edges of the wound as soon as the skin had been divided, and any exposed flaps were similarly protected. In spite of all these precautions, which are of course usual even in British surgery, but which require emphasis in Malta, suture abscesses

were not uncommon, nor was it rare for such small abscesses to develop after the sutures had been removed, especially in the case of large wounds of the lower limbs, such as those required for the removal of varicose veins or for the plating of simple fractures. Fortunately these drawbacks were technical rather than important, and I never saw infections spread below the skin ; it appeared to me that in the majority of the cases mentioned the infection occurred after rather than at the time of the operation, and that it was due to the accumulation of perspiration under the dressings—which moreover we had to make as small and light as possible. I had occasion to perform many excisions of semilunar cartilages, operations for varix and varicocele, and such operations as appendicectomy, gastro-enterostomy, sigmoidectomy, hysterectomy, ovariotomy, decompression for cerebral tumour, nerve suture, ligature of arteries, and plating of simple fractures, and I had only one case in which deep suppuration ensued, nor do I know all the circumstances of this case (plating of a tibia) as I left the island before the sutures were removed. I understand that the Maltese surgeons avoid as far as possible operating in the very hot weather, but, apart from the general inconveniences and necessity for a little extra care, I see no reason why, if assistants are properly trained (which was by no means always the case in our work), aseptic surgery should not be carried on throughout the year as in England.

Turning to the question of *septic wounds*, it has been already indicated that those received from Gallipoli were often in a most serious condition, as many of the patients had been transferred from the first dressing stations to hospital ships in which they had to remain for a good many days before we received them. Under such circumstances, as in all military surgery, the use of antiseptics was a constantly debated question. Before my arrival the solutions principally used were, I believe, those of carbolic acid and lysol and the mercurial compounds, hypochlorous acid not yet having been introduced. Within a very short time after I landed Professor Lorrain Smith communicated to me his work upon "eupad" and "eusol," and I devoted a good deal of time to comparing these with other antiseptics. The dry preparation of eupad—a mixture of equal parts of bleaching powder and boracic acid—was introduced into drainage tubes, and was used in gauze bags ; but I soon came to the conclusion that it caused the formation of too abundant grey and œdematous granulations, which interfered with drainage, and which, if deeply seated, embarrassed the circulation, so that the use of this powder was soon abandoned. Eusol, on the other hand, was very freely used, and soon demonstrated its popularity. By comparison with other antiseptics I was never able to satisfy myself that it had any great advantages beyond economy and absence of any risk of poisoning, although on the other hand it appeared to be at least equally effective. I preferred to have the solutions made isotonic, and in not a few cases they were used with sodium chloride as a hypertonic solution either in baths or for irrigation. In all cases in which eusol was employed

the protection of the skin was even more important than in cooler countries, and for this purpose firm painting with liquid paraffin on a camel-hair brush is decidedly superior to the use of gauze smeared with vaseline; the paraffin is sterilized by placing the bottle in a water-bath and boiling the water for some twenty minutes, while the brushes are kept in ether and dried before use. If by this means the solution be firmly rubbed into the skin, around and close up to the edges of the wound a very impervious coating is produced, beneath which discharges cannot penetrate as they are liable to do with vaselined gauze. The Carrel-Dakin method of using hypochlorous acid was not employed in Malta until the spring of 1917, and as the number of septic cases had now become comparatively small, we had few opportunities of comparing it with our earlier methods. Cases arriving from Salonika with Carrel's tubes appeared on the whole to be in rather better condition than those otherwise treated, but any deductions founded upon such evidence would be fallacious in the absence of an exact knowledge of the conditions then prevailing in the Salonika hospitals and influencing their evacuation. The very great majority of our cases were on arrival of too old a date for much to be expected from the use of Rutherford Morison's bismuth and iodoform paste, although in some few instances we found it of great value, sinuses and pus collections being opened up, smeared with the paste, and then closed with rapid healing; in one case only the free use of the paste, in a case of extensive sinuses connected with a compound fracture of the femur, caused serious symptoms, but in this instance the paste was not merely smeared over the surfaces but packed in in bulk. Some of the newer antiseptics such as brilliant green, flavine and dichloramine-T were not obtainable in Malta up to the time of my departure.

Very considerable use was made of saline solution, both isotonic and hypertonic, and in many cases—especially after operations for sequestrotomy—we introduced solid sodium chloride and citrate into deep recesses of joints or the fractured ends of bones, but again I find it impossible to say that the clinical results were distinctly either better or worse than those obtained by the use of antiseptic solutions. I was however much impressed with the rapid healing and absence of complications in severe wounds received while the sufferers were actually immersed in salt water, that is to say, in those who, being on torpedoed vessels, were injured after or immediately before having been thrown into the sea, but most of these wounds were due to being struck by debris, and it is not possible to regard them as on the same plane with gunshot wounds.

Peroxide of hydrogen was freely used for dressings until, towards the end of our period, it became difficult to obtain. Its one great advantage over other solutions is the facility with which it loosens adherent dressings, but for purposes of irrigation of wounds which are not plane surfaces, it should, I think, be strongly deprecated, as it opens up sinuses without having any reliable disinfecting action, is hence often exceedingly painful

and disturbs the granulation tissue in its efforts to close sinuses and cavities.

I have dwelt at some length upon these questions as they have given rise to so much debate in England and France, and as we had exceptional opportunities for prolonged observation of our cases. The one outstanding conclusion however at which I arrived is that the nature of the dressing or lotion used made but little, if any, difference, and that (apart from early cleaning and excision of wounds, which we could not practise in Malta), the essential conditions are thorough drainage, the continuous search for and immediate opening of new tracks and pockets, care and gentleness in handling granulation tissue and newly-formed fibrous tissue, and the avoidance of all unnecessary surgical interference (including probing and washing out or *in*) during the long period of septic inflammation. It is impossible to over-emphasize the importance of gentleness during dressings, especially when, as in much military surgery, these are performed by imperfectly skilled hands, and in this connexion I am afraid that not enough use is made of non-adherent coverings for the granulating surfaces. For such covering thoroughly perforated oil-silk is most valuable, although but little used; christia, which is supplied as a cheaper substitute, is decidedly inferior and liable to soften and curl up. The perforated celluloid recommended by Captain Douglas I was unable to obtain in Malta except through private sources; for covering flat surfaces it is admirable, but I was unable to soften it sufficiently for irregular surfaces, and I could not satisfy myself that it had any real value as splinting and immobilizing the soft tissues; some perforated wax paper supplied from home as a substitute became too soft to have any real value, and tended to stick to discharges. In order to diminish the pain of wound dressing nikalgen was tried, but was quickly abandoned as not appearing to have any real value; apart from this it would appear that any form of local anæsthetic is of doubtful benefit as it only masks pain, does not actually protect the surface from mechanical injury, and hence tends to encourage the very roughness which it is so important to avoid. If sufficient care and time be given the dressing of most wounds need cause little pain, and apart altogether from local conditions, much mental strain may thus be avoided, for which reason I would again emphasize the importance of thoroughly greasing the skin with liquid paraffin and covering the wound with a thoroughly perforated non-adherent material. As to injury of young cicatricial tissue either by incisions or still worse by bruising, it has to be constantly borne in mind that every surgical procedure in such tissue opens up new lymphatic and vascular tracks and increases the difficulty which the tissues find in disposing of micro-organisms; hence it was necessary constantly to discourage premature attempts at removal of foreign bodies or sequestra and to insist on the fact that micro-organisms remain buried in granulation tissue long after acute septic conditions have subsided. As an illustration of the danger run in dealing with recently inflamed tissues I may mention

the case of a lad who, in addition to having a healed wound of the thigh, required a re-amputation of the leg. The amputation gave no trouble, but a large abscess promptly developed in the thigh, and could only be attributed to the pressure of the tourniquet on the recent scar. Numerous cases were also seen in which quite slight operations for sequestrotomy in a late secondary period were followed by sufficiently serious results.

Passing to the *special infections of wounds*, we find little of importance to note. Gas gangrene was never common after my arrival in Malta, possibly because infected cases were unable to bear the journey from Gallipoli, but more probably because the uncultivated soil on which the campaign was fought did not tend to be so highly infected as that of France. Similarly, during the winter which I spent in Salonika, I saw but one case of gas infection of a comparatively mild type, although I am aware that others were met with. Tetanus also was uncommon even in 1915, and I saw only about half a dozen cases with one death. The fatal case was admitted from Salonika in the spring of 1917, with an amputation at the shoulder joint, which had been completely healed for at least three months. The patient was apparently quite well when he was suddenly attacked one morning with violent pain in the stump; I saw him on the following day, when he had typical tetanus with opisthotonus, and although treated at once with large doses of serum both intravenously and intrathecally, he died within about forty-eight hours of the onset of the pain. On investigation we found that at Salonika he had had a gas infection, that tetanus-like organisms were found in his wound secretion, and that at least four or possibly five injections of antitetanic serum were there given hypodermically. Among special infections may perhaps also be mentioned the *Bacillus pyocyaneus*, which during the early part of 1916 was very frequently met with in Malta; as in other areas its presence seldom appeared to be of serious import, and I almost came to regard it as of good prognosis in suppurating wounds.[1] In Salonika I also saw several cases of anthrax within a short period during the winter of 1915-16, but we were unable to trace these to any common source, and at a later date I saw none in Malta.

A review of the general surgical conditions in the Mediterranean would be incomplete without some reference to the question of *shock*. Among the cases arriving from Gallipoli the general depression and the tendency to surgical shock was often extreme, many of the wounded having been previously exposed to most arduous conditions and subsequently to the voyage, for which not all were equipped by nature or habit, while probably long deprivation of a sufficiency of drinking water increased their prostration. In these cases the provision of abundance of fluid was important and

[1] The same point has been recently referred to by Kellock and Harrison, and may be due to the *Bacillus pyocyaneus* serving to displace other and more dangerous organisms, as is suggested for the "Reading bacillus" of Donaldson and Joyce.

operations had to be undertaken with the prospect of very considerable shock, for which suitable precautions, such as the intravenous injection of saline solution were essential.

At a later period such severe cases were not met with and operations on reasonably healthy patients were associated with peculiarly little shock, probably owing to the high atmospheric temperature; in no one of many operations for abdominal diseases did shock give me the slightest anxiety.

Having thus noted some of the general conditions of surgery in Malta, a short reference may be made to wounds of various regions of the body, and, although the numbers of cases seen are insignificant in comparison with those met with in France, these allow of a few deductions which have the advantage of being founded on a longer period of continuous observation than is possible in the French hospitals.

Having regard to the conditions of transport it was inevitable that during the Gallipoli campaign *head injuries* should arrive in bad condition. At a later date they became comparatively rare, the majority no doubt being treated at Salonika, although it is noticeable that no very large number of convalescents arrive thence in Malta. During the autumn of 1915 most of the serious perforating injuries of the head were admitted to Baviere Hospital, where I was able to obtain some definite if not extensive statistics, which may be taken as fairly representing my experience in other hospitals. Of 33 cases admitted to Baviere, 15 died, and 18 were sufficiently recovered to be sent to England, which implies that they had recovered *quoad vitam* but by no means necessarily *quoad sanitatem*; of those which died the majority were obviously in a hopeless condition on admission, and all the deaths were due to general meningitis. Eleven cases had been operated upon before arrival and among these the most noticeable feature was the association between wound-sutures and mortality; 5 died and 6 lived; of the 5 fatal cases 4 had sutured flaps and 1 a large hernia; of the 6 which recovered none had been sutured. Judging from these and general observations of other cases which passed through our hands, it was clear that flap operations with suture of the flaps were in the Mediterranean almost invariably fatal, and in two years I saw only one or two cases leave Malta alive. On the other hand, and apart from the nature of the injury, cases not thus closed presented much better results. Twenty-two cases of compound fracture of the skull had not been operated upon before arrival and 2 others were obviously incompletely treated, so that 24 in all required surgical intervention in Malta. The rule adopted was to operate on all these cases, however hopeless the condition might appear to be; thus 7 presented definite symptoms of general meningitis on arrival and the total results were naturally not statistically good, although probably a good many were saved which would otherwise have died. Of the 24 cases 11 died, and 13 were sent to England; of the 11 deaths 7 had general meningitis at the time of operation and 2 were smashes of the parietal region of at least

the size of the palm of the hand. Of the 13 recoveries all had depression and fragmentation of the inner table of the skull, in 9 the dura mater was perforated, in 3 others we found an extradural abscess, a subdural abscess, and blackened dura mater with blood-clot external to it, while in 1 only were the meninges uninjured. One of the cases which recovered had general meningitis in addition to hemiplegia due to his focal injury.

In all these late and very septic cases I used tri-radiate or longitudinal incisions passing through the original wound, and no attempt was made to made flaps as aseptic healing was obviously impossible; for the same reason no sutures were used. The scalp was cleaned as thoroughly as possible, and throughout the operation the area was freely douched with a solution of perchloride of mercury; at its conclusion all exposed tissue was washed with ether and as a first dressing I used gauze soaked in ether, eusol being generally employed afterwards, although alcohol or a watery solution of formalin were both employed in many cases and alcoholic solutions were preferred in all cases of hernia. It was very noticeable that in those cases left open hernia cerebri was not common and a little consideration will show that in the presence of extensive sepsis closure of the wound could only do harm, and that it is wiser to allow granulation tissue to protrude than, fearing such protrusion, to close the aperature and thereby increase the intracranial tension and eventually produce a larger expulsion of brain substance.

With regard to the mortality of these cerebral injuries it is interesting to note the extreme importance of region in determining the prognosis. Dividing the skull roughly into three areas—the frontal, parietal, and the occipital—we find that of frontal injuries all (6) recovered; in the parietal region there were 8 deaths and 6 recoveries; and in the occipital region there were 3 deaths and only 1 recovery. Similar ratios have been constantly noted in the past and are thus merely confirmed, while conversely they assist us in confirming the general accuracy of the deduction from the few figures here given.

Injuries of the *spinal cord* arrived only in small numbers and, as the very great majority of those which we saw were obviously hopeless, we made every effort to send them to England and operative treatment was rare, there being but two cases in which I thought it advisable to perform laminectomy; in both of these the operation was unfortunately late, but in one it probably saved the patient from the worst results of his injury, while in the other it failed to relieve the pain for which it was undertaken.

Pte. A. S. was wounded in Gallipoli on June 11, 1915, but only came under my care in the following August. He presented a complete flaccid paralysis of the lower limbs with paralysis of the bladder and rectum and anæsthesia nearly to the level of the groins. The radiogram showed a shrapnel bullet lying in the spinal canal opposite to the body of the second lumbar vertebra and it was clear that the cauda equina was compressed if not torn by it. Two operations had already been performed without

discovering the bullet and naturally without relief. As the patient was suffering intense pain I exposed the affected region and found the bullet lying slightly to the right of the middle line and opposite the upper part of the second lumbar body. The left side of the cauda formed a dense cicatricial mass, while on the right was a gap in the cicatrix occupied by the bullet. There was, of course, no difficulty in removing the latter but it was impossible to dissociate the matted nerves and the extent of the scar rendered resection and suture impossible, so that I was only able to bring together with catgut the gap left by the removal of the foreign body. A year later, I heard that this patient was still suffering intense pain and it would seem useless to hope for recovery at any later date ; probably the best course would now be to excise the whole scar and aim only at relief of pain, but an earlier operation would have given good prospects in a case of this type.

Pte. E. R. was admitted from Salonika, coming under my care about three weeks after he had received a bullet wound of the back 2½ inches to the left of the third dorsal spinous process; the wound was nearly healed and a radiogram showed a shrapnel bullet lying to the right of the vertebral column over the fifth costo-vertebral joint on its dorsal aspect. The track of the bullet was indicated by a slight deposit of lead on the fifth dorsal spinous process. This patient presented complete paraplegia of the trunk and lower limbs with retention of urine, loss of knee-jerks, ankle-jerks, and plantar and cremaster reflexes ; but retention of the superficial abdominal reflexes ; anæsthesia involved the legs, thigh and trunk to the level of the seventh rib on the left and the sixth on the right side with the exception that he had a vague sense of contact in both feet. This anæsthesia was complete to touch by cotton wool or to the prick of a pin, but he retained some deep sensation and could indicate whether the great toe was flexed or extended while on heavy pressure he knew which limb was being touched. Bedsores were present over the sacrum and on both heels.

The general aspect of the case was that of a complete destruction but the slight retention of sensory function encouraged me to hope that it might not be hopeless, and on exposure, I found the fourth dorsal spinous process with its laminæ broken off, although little, if at all displaced. This bony fragment having been removed the theca was laid bare from the second to the fifth arches and was found to be surrounded by a newly formed fibrous cicatrix which was dissected away. The theca was then opened and the cord presented no naked-eye abnormality. Recovery was slow but definite and thirteen months after the operation the patient writes me that he can now walk " with assistance."

The interest of this case lies in the fact that the retention of even a trace of function in the spinal cord below the level of the wound gives us ground for hope and that in such cases the injured structure should be placed as soon as possible in a position in which it will not be subjected to

cicatricial pressure. It is usually possible to determine at a very early date whether a paraplegia is due merely to concussion, and this point having been determined the sooner the cord is set free from all anatomical embarrassment the better.

Of injuries to *peripheral nerves* we had many but, as all arrived too late for primary suture and it was impracticable to retain them until ready for secondary suture, the great majority were sent to England and throughout most of the period referred to I operated only for the relief of pain. In several of these cases the removal of very recent cicatrices from around nerve trunks was readily effected and was followed by immediate relief of pain and by very rapid recovery of function in paralysed or anæsthetic but undivided nerves. Towards the end of the time owing to the difficulty with regard to hospital ships, patients remained with us much longer and nerve suture was performed more often. The results differed in no way from those obtained at home but I know of no cases retained long enough to expect recovery of function after suture of a large trunk.

Operations for *secondary hæmorrhage* were naturally common among the highly septic cases received from Gallipoli and it appeared to me that such cases were more prone to gangrene than in England and France, possibly on account of the great exhaustion of the patients before being wounded, of the severity of the sepsis or of the difficulty of obtaining and maintaining asepsis of the skin. On the other hand a number of aseptic operations for aneurysm and arterio-venous communication gave uniformly good results.

Abdominal injuries only came before us at a late stage and the number of convalescent cases seen on their way to England was small. In some half a dozen instances I operated to close intestinal fistulæ and these gave no trouble. Wounds of the *chest* also presented no points of special interest.

Compound fractures and wounds of large joints were met with in large numbers and presented no problems other than those with which the profession is now thoroughly familiar. These cases we also received at a late date and often in a condition of extreme and extensive sepsis. Under such circumstances I am satisfied that surgical interference should only be adopted when absolutely essential and should be of the most restricted type. Attempts at excision of joints or of extensive removal of bone gave most unsatisfactory results and would often relight or aggravate the acute condition. The best results were obtained by keeping a careful look out for points of tension with local relief of such points and without attempts to remove sequestra or foreign bodies unless they were readily accessible. Even in cases of some months standing, sequestrotomy was seldom satisfactory unless removal of the dead bone could be effected with precision and without unnecessary bruising or other disturbance of tissue, while careful drainage was necessary even in the case of very late operations. In the knee-joint especially I found that excisions three or four weeks after the

original wound did not save the limb, and when the free incision of pouches and pockets of pus was not followed by rapid improvement it was generally advisable to amputate without delay. These conclusions, arrived at from watching cases for a longer period than those treated in France, will probably be confirmed by the experience of late results as obtained in British base hospitals and, depressing as it is, amputation will I think prove to be the best method of treating many of the more serious injuries of the lower limbs which are at present being dealt with by more conservative attempts whose success is only too often very problematical.

It will be obvious from remarks already made that after the evacuation of Gallipoli a great deal of our surgical work was concerned not so much with war wounds as with the treatment of diseases incidental to this particular war zone or with that of ordinary surgical conditions under somewhat abnormal conditions, and to some of these conditions we may now refer.

After June of 1916 when cases of *malaria* began to arrive in large numbers from Salonika the co-existence of this disease had to be considered in connexion with all surgical injuries and it became the exception rather than the rule to operate upon men who had not recently been suffering from malarial infection.

In such cases if a febrile attack happened to be in progress we endeavoured at least to postpone operations until its close and in all others a previous preparation by a three or four days' course of quinine was if possible adopted. In spite of these precautions it was however quite common to find recurrences of malarial fever on the first or second day after even trivial operations, but apart from occasional difficulties of interpretation and diagnosis due to rises of temperature, I saw no case in which I could regard the complication as a serious one. Exact statistics I cannot give but there can be little doubt that in the second half of 1916 at least seventy-five per cent of all our admissions were malarious subjects, and in one hospital where a record was kept we found that three-quarters of the cases of minor operations upon patients known to be malarious showed rises of temperature not explicable by the surgical condition, although only twelve per cent had rigors. It was especially noticeable that these attacks of post-operative malaria were more liable to occur in cases in which the operation could not be fully aseptic and hence in such comparatively slight proceedings as removal of tonsils, opening abscesses, removal of hæmorrhoids and the like. On the other hand, I do not recall an instance of malarial fever following any serious aseptic operation although the obvious fallacy presents itself that such operations were not likely to be undertaken in malarious patients. As illustrating this connexion of malarial recurrence with slight sepsis we may refer to a case of aseptic amputation of a stiff finger in a man who had had frequent attacks of malaria; he had no rise of temperature after the operation, but, the sutures being removed on the seventh day, the temperature rose suddenly to 102° F.

on the eighth day, and it is at least possible that we may assign this result to some minor skin infection in connexion with the suture removal, such skin infections being as we have seen extremely common. Be this as it may the fact impressed itself strongly upon me that the appearance of malaria after operation was probably due to the presence of some infection however slight rather than to the mechanical lesion.

Along with malaria *dysentery* greatly influenced the whole of our work, both by providing lesions of surgical importance and by complicating the question of diagnosis. It has to be constantly borne in mind that dysentery, in the usual significance of the term, is but a symptom of amœbiasis and thus we were not seldom called upon to treat dysenteric abscesses of the liver in men who had no previous history of diarrhœa. On the other hand many cases of comparatively mild intestinal dysentery commenced rather suddenly with general "abdominal symptoms" and pain, which was often localized for at least some days in the right iliac fossa, thus rendering by no means easy a diagnosis between dysentery and appendicitis as illustrated by the two following cases seen on two consecutive days.

Pte. M. was admitted to Imtarfa Hospital on July 26, 1916, as a case of convalescent dysentery, and was on August 19 ordered ordinary diet. For four days he then had a slight evening rise of temperature to which no importance was attributed. On August 21 he complained of sudden and severe pain in the right iliac fossa, the temperature rose to 100° F. and pulse to 120; the bowels were constipated; he had no vomiting. When I first saw him on August 23 he was evidently very ill, the temperature and pulse-rate were as on the 21st, the whole abdomen was full and somewhat tumid with definite rigidity of the right rectus and great pain localized in the right iliac fossa, whence it extended down to the right thigh. Absence of vomiting was the only departure from the classical picture of appendicitis, and I at once operated as for that disease. No free fluid was found in the abdomen; the cæcum, appendix, and so much of the small intestine as presented in the incision were all congested and somewhat œdematous. The appendix, which was removed, did not differ in appearance from other parts of the bowel or present any condition capable of evoking the symptoms. Immediately after operation emetine treatment, which had been discontinued for some weeks, was resumed. Symptoms were by no means immediately relieved, the pyrexia and general abdominal distension remaining for some ten days, after which recovery was complete. At no time was there any diarrhœa.

Pte. W. developed dysentery at Salonika in June, 1916, and was admitted to Imtarfa Hospital on August 16. He was apparently making a normal convalescence when on August 21 he vomited once and was said to have had a little blood in the vomit. For the following two days he again appeared to be quite well, and on August 23 he was allowed to get out of bed for the first time since admission. On the evening of this day he was seized with sharp pain in the right iliac fossa and the temperature

rose to 99·6° F.; there was no recurrence of the vomiting. I saw him on the following day, when he complained of aching pain in the right iliac fossa, where he had considerable tenderness, resistance and cutaneous hyperæsthesia. The abdomen presented exactly the same general fullness and tumidity as did that of the previous patient. In this case operation was deferred until the following day, when the localized pain and rigidity had become much more marked and there was also pain on passing urine. On now opening the abdomen I found the cæcum much congested, œdematous and thick-walled, but in contrast with the last case the appendix was suppurating and differed in no way from the ordinary acutely inflamed structure, while it was surrounded by a small amount of peritoneal exudation. Unfortunately no more complete pathological examination was made, and the specimen was thrown away without any search for dysentery-producing organisms. In this case there was no post-operative emetine treatment, and symptoms passed off rapidly and without such delayed convalescence as met with in the last case.

These two examples, which could easily be multiplied, serve to illustrate the difficulty of diagnosis which is not lessened by the possibility of meeting with a truly amœbic appendicitis, although I was never able to satisfy myself of the occurrence of this condition in Malta, and regarded all the cases of appendicitis in dysenteric subjects as intercurrent or at most as predisposed to by the bowel lesion.

Apart from such occasional difficulties of diagnosis, amœbiasis provided us with a considerable amount of surgical work. Perforations of the intestine were met with, but of these two only came under my own observation; both were *in extremis*, one dying on the way to the operating theatre and the other very shortly after operation, but the general experience of these very serious cases was most unfavourable, and I can recall only one instance of recovery after early operation. In some of the earlier cases of severe dysenteric colitis the operation of appendicostomy was practised, but was, I believe, soon abandoned, and I did not personally meet with any cases in which I thought it likely to be of service. With the value of this proceeding in old-standing cases of colitis we are not now concerned; all our cases were recent and acute, and in those which could not be dealt with by medicinal methods, including, of course, the invaluable emetine, the condition was too desperate to allow of much hope from a somewhat serious operation, which in any case could only deal with the large intestine and was useless as a direct attack upon the small bowel or upon the intense toxæmia.

Having regard to the large amount of dysentery and the large number of cases of enlarged liver which passed through our hospitals, *abscess of the liver* requiring surgical operation was by no means common, and there can, I think, be no question that this comparative rarity was due to the early recognition of the disease and its prompt treatment by emetine. In many cases I saw enlargements of the liver, often to an extent which made almost

certain the presence of a large abscess, but in which complete return to the normal size was attained after a ten days' course of emetine, and the cases calling for operation were generally those which had been overlooked or those in which had occurred some complication such as a perforation. I would also attribute to the use of emetine immediately after operation the fact that the results of operation were very good even in complicated cases, such as rupture into the stomach or peritoneum. Of some two dozen personal cases all recovered except two, one of which had before operation general peritonitis from rupture, while the other had double empyema and also a very severe attack of malignant malaria. In all cases requiring operation I adopted the open method and used a drainage tube, nor do I think those which I saw could be dealt with in any other way. No doubt some of the large livers which yielded to medicinal treatment might, if explored with the needle, have been found to contain "abscesses" and might have given good results from aspiration, but as the results were sufficiently satisfactory without any surgical interference I see no reason to regret not having adopted this proceeding. I know of no instance in which post-mortem examination revealed an abscess overlooked during life, and can only conclude that in our cases either recovery could be obtained by drugs, or that, failing these, it was wise to follow the general principles of surgery. Putting the matter in another way, we may perhaps say that a purely amœboid infection will yield to emetine, whereas an infection associated with pyogenic bacteria demands drainage.

In connexion with the question of liver abscesses I may quote one more case as an example both of the occasional difficulties of diagnosis and of the results of combining operation with the use of emetine.

Pte. S., an R.A.M.C. orderly, was admitted to Valletta Hospital on the afternoon of April 6, 1916. He had been serving in Malta only and up to this date I had not heard of any cases of dysentery originating in the island, nor had he any history of diarrhœa. He said that for about a fortnight he had been "feeling feverish" and that he had had some bronchitis, but he did not report sick until 2 p.m. on the day of admission. At that hour he was attacked by acute abdominal pain more marked on the right side. At 3 p.m. he vomited a small quantity of yellow fluid, and at 5 p.m. he was seen by Lieutenant Gillies, who found acute pain of the right abdomen mainly in the upper half, with tenderness in the right hypochondrium, and to a less extent in the right iliac fossa. When I saw him an hour later he was evidently acutely ill and presented symptoms as already described, except that the pain was more marked in the right iliac fossa and tenderness appeared to me to be more severe there than elsewhere. The liver dullness was normal; there was some general bronchitis. The diagnosis appeared now to lie between that of appendicitis and a perforation of the duodenum. An incision over the appendix revealed only a large quantity of odourless fluid. A second incision through the upper part of the right rectus muscle gave exit to more free fluid and to some

odourless grey debris. The gall bladder and duodenum having been found to be normal I discovered on the under surface of the quadrate lobe of the liver and close to the longitudinal fissure a cavity large enough to admit the terminal segment of the thumb and giving exit to a pale grey pus, and it was clear that we had here a hepatic abscess which had ruptured into the peritoneum. After abdominal toilet a drainage tube was inserted into the abscess cavity and another into the adjacent peritoneum. The pus removed was found to contain amœbæ, and emetine was used from the morning after the operation, $\frac{2}{3}$ grain being given by the mouth daily for nineteen days. Amœbæ were found in the pus from the drainage tube on the first, third, fifth and sixth days after operation, but at no later date; recovery was complete.

An interesting but somewhat obscure condition of which I saw several cases in the autumn of 1915, was *thyroiditis*, possibly of dysenteric origin. In these patients most if not all of whom were convalescent from dysentery, the thyroid gland became enlarged, painful, very hard and very tender on one or both sides, and it differed entirely from the soft swollen thyroids with which we became familiar in men presenting marked nervous symptoms. The swelling, which was not uniform but generally fairly limited, was wanting in the definition of an adenoma, while its somewhat vague outline and marked hardness recalled rather the appearance of an early case of malignant disease; there were no concomitant symptoms of hyperthyroidea. Those cases which I saw varied a good deal in size from time to time, but all tended to gradual recovery without any special treatment, and I much regret that during the period of their incidence it did not occur to me that they might be dysenteric in origin, and consequently I did not further investigate them. After the autumn of 1915 I saw no more of such cases, possibly because of the increasing use of emetine in the primary dysentery, but at Salonika I met with one in a man who had also had dysentery, and who developed an abscess in the thyroid isthmus; in this case an examination of the pus failed to reveal any organism which could be cultivated; amœbæ were, however, not looked for, and it was too late to do so when I saw the case.

I cannot conclude this hasty and imperfect account of over two years of surgical work in the Mediterranean without an equally imperfect expression of my sincere thanks to those men and women of all ranks whose loyal help and constant good humour under many trials have been the happiest feature of that work. From many of them I have learnt much and, on the other hand, I always found them ready to adopt new ideas or to carry out my own suggestions. I have purposely avoided mentioning any of their names, as to do so would have involved me in an invidious selection from among too many of my friends. But I am sure that they will feel, as I shall, in the years to come, that the recollection of having worked together in Malta is a link of friendship more binding than many an acquaintance of far older date.

SOME EXPERIMENTAL OBSERVATIONS ON PERFORATING WOUNDS OF THE ABDOMINAL VISCERA.

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Paragraph 1.

We have set ourselves to work out experimentally certain facts regarding penetrating wounds of the abdomen regarding which the clinical evidence is at present somewhat obscure.

The first question with which we shall deal is that of, "*To what extent can perforating wounds of the intestine recover without operation?*"

It is undoubtedly a fact that certain cases of perforating wounds of the intestine recover without operation—clinical evidence of this has been obtained during the present campaign. It is our purpose to test the experimental evidence and, if possible, to indicate the circumstances under which such a possibility may be expected to occur.

During the South African War of 1899-1902, owing to the difficulties of transport, and the lack of suitably equipped hospitals close to the firing line, comparatively few of these cases were operated upon. Surgeon-General Stevenson in the official history collected only 207 cases of "gunshot wounds of the abdomen," with twenty-six laparotomies, of which eighteen died. A certain proportion of the cases recovered without operation, and this fact, in the early stages of the present campaign, undoubtedly modified for a time the treatment of such cases. It may be assumed that the universal opinion now is that early operation offers the best chance of recovery. Makins states: "Perforating wounds of the small intestine are very fatal injuries. Every person in whom this condition was certainly diagnosed, died."

As we have said, the first part of our experimental work was done with a view to putting the possibility of spontaneous recovery upon some definite basis. We found that bullet wounds of the intestine can be very closely simulated by cutting the gut wall with small sharp scissors. Such wounds show the typical pouting of the mucous membrane in its rosette-like form, no matter what part of the alimentary canal is injured, and Colonel Wallace, A.M.S., has made the observation that these wounds exactly simulate bullet wounds of the intestine, both macroscopically and on examination with the microscope. Into each wound so produced a lead

shot was introduced. The following account applies to such *single small wounds* :—

When single small wounds were made in either small or large intestine, we invariably found that the animal recovered. Usually the animal ate little or nothing on the day following operation, but on the second day normal diet was resumed. With such wounds a small amount of extravasation occurs at the time of the wounding, and the degree of the extravasation depends apparently upon the amount of contents of the gut at the time.

Multiple small Wounds.—Our next observation showed that several wounds of the same size (small) could be made in the same loop of intestine, and recovery follow. As many as five perforations could be made in the same loop of intestine, one inch of healthy bowel existing between each, and the animal recover. As a rule, when more than five perforations were made in the single loop of bowel, the animal died of general peritonitis. For example, experiment 20.

Summary.

Bullet wounds of the intestinal tract can be closely simulated experimentally. Single artificially-made wounds of small size recover, irrespective of the portion of the intestinal tract in which they may occur. Multiple small experimental wounds occasionally undergo spontaneous recovery, but, if too numerous, are fatal.

Protocol of Experiments : Part I.

No. 1. *Animal : hare. Wound of Middle of Ileum.*—September 5, 1916 : Laparotomy in middle line. Single small perforation made in bowel about middle of ileum with fine scissors ; the wound showed well the prolapsed mucous membrane. A No. 4 shot was introduced into the bowel through the wound in the gut. No escape of intestinal contents. Loop replaced into peritoneal cavity and abdomen closed. September 7, complete recovery.

No. 6. *Animal : hare. Wound of Upper Part of Ileum.*—September 5, 1916 : Laparotomy in middle line. Three small wounds made in bowel at this point. The perforations were made on the anti-mesenteric border, two inches of healthy bowel existing between each perforation. Into each perforation a No. 4 lead shot was introduced. All perforations had the typical rosette appearance of the prolapsed mucosa. A small amount of bile-stained contents escaped on replacing the wounded loop back into the peritoneal cavity. Abdomen closed. September 6 : Animal well, eating a little, moves freely about. September 7 : Animal quite normal again.

No. 8. *Animal : hare. Wound of Lower Part of Ileum.*—Septem-

ber 7, 1916: Etherized; laparotomy middle line. Lowest loop of ileum identified and three perforations made along the anti-mesenteric border; shot introduced into bowel as in previous experiment. The bowel showed little escape of intestinal contents and was replaced in abdomen. September 8: Animal quiet, looks well, has eaten a little. September 9: Recovered completely.

No. 11. *Animal: hare. Colon Wound.*—September 15, 1916: Laparotomy in middle line. The colon was identified and two small perforations made in it about two inches apart. Lead shot were slipped into the bowel in the usual way. One perforation was made between the longitudinal bands through the circular fibres, while the other was made through the longitudinal band on the anti-mesenteric border. September 16, 1916: Animal well and eating a little. September 19: Animal completely recovered.

No. 12. *Animal: hare. Colon Wound.*—September 15, 1916: Laparotomy. Colon perforated in a similar way as in previous experiment and bowel replaced into abdomen. September 17: Animal did well, ate day following operation.

No. 18. *Animal: hare. Jejunum Wound.*—September 24, 1916: Laparotomy middle line. Loop of upper jejunum brought out of wound 1½ inches from upper fixed end. Three perforations were made in the bowel, one inch of healthy bowel existing between each wound. Lead shot introduced through the prolapsing mucosa into the lumen of the gut. Straightforward recovery.

No. 20. *Animal: hare. Multiple Wounds of Small Intestine.*—September 28, 1916: Laparotomy middle line. Multiple small perforations; four made in the lowest loop of ileum; a similar number made in the middle of the small intestine and also in the jejunum. The stomach was noticed to be half full at the time of operation. Abdomen closed. Animal died ten hours later from a general peritonitis. There had been a considerable amount of extravasation of intestinal contents and more marked from the upper series of perforations, for there was a considerable amount of bile-stained fluid in the upper part of the abdomen among the coils of small gut.

No. 22. *Animal: hare. Wounds of Ileum.*—September 29, 1916: Laparotomy middle line. Five small perforations made in the lower ileum. Shot introduced into bowel through the prolapsing mucous membrane. September 30: Animal well; made good recovery.

No. 24. *Animal: hare. Wound of Rectum.*—October 11, 1916: Laparotomy middle line. Perforation made in rectum, the usual small wound being made with scissors. Animal ate freely on the following day and made a perfect recovery.

No. 25. *Animal: hare. Wound of Cæcum.*—October 12, 1916:

Laparotomy. Wound of cæcum made, small size, just large enough to introduce a No. 4 shot into the bowel through the perforation. No extravasation occurred at the time. Uneventful recovery.

No. E 15. *Animal: hare.*—September 18, 1916: Laparotomy in middle line. Two small perforations made in lower ileum four inches from the fixed end. Typical eversion of mucosa seen; shot introduced into the bowel. September 20: Animal quite recovered.

Paragraph 2.

The second question which we attempted to answer was as follows:—

If perforation of the intestinal tract occurs, is there any one portion of the gut that has a greater tendency to spontaneous cure than another?

Clinical evidence on this point is somewhat meagre. We know, however, that certain stomach wounds, which from their anatomical position are impossible of suture, may close spontaneously, and we have had personal experience of intra-peritoneal rectal wounds, occurring at the extreme lower limit of the pouch of Douglas, where the wound spontaneously closed.

We have made experimental wounds of varying size in all the various subsections of the intestinal tract, and we have tried to arrive at definite conclusions as regards the possibility of spontaneous closure in the varying subsections. Belgian hares and cats were employed in the experimental part. The various portions of the intestinal tract will be dealt with independently.

Stomach Wounds.

When small wounds were made there was a spontaneous recovery; by small wounds we mean those which were just sufficiently large to admit No. 4 shot. When larger wounds were made the animal succumbed; but one must add that if the wound was purposely covered with omentum—a wound even so large as to admit the finger tip—the animal recovered.

Wounds of Duodenum and Upper Jejunum.—These were found to be inevitably fatal. Apparently the escape of bile and digestive fluids, which occurs in this situation, prevent natural adhesions by omentum or peritoneum.

Wounds of Lower Jejunum and Ileum.—These showed a strong tendency to spontaneous cure. Omental and peritoneal adhesions formed, and eventually there was complete closure of the opening with very little scarring.

Wounds of the Large Intestine.—These wounds were found to be inevitably fatal.

Summary.

Wounds of the ileum show a greater tendency to spontaneous recovery than any other part of the intestinal tract.

Protocol of Experiments (relating to Paragraph 2).

No. 9. *Animal: hare.*—September 7, 1916: Etherized; laparotomy in middle line. Longitudinal incision made in the lowest loop of the ileum four inches from the cæcum. Incision in bowel about ¼ inch in length. The intestine was fairly empty at the time of production of the wound. The animal was always quiet from the time it recovered from the anæsthetic, and it died fourteen hours later. Post-mortem showed acute general peritonitis, with very marked local extravasation.

No. 14. *Animal: hare.*—September 15, 1916: Laparotomy in middle line. Small intestine, high up in jejunum, exposed; bowel half divided across transversely. Small amount of bile-stained contents escaped at the time of production of wound. Animal died nine hours later from peritonitis; there was considerable amount of bile-stained contents in the upper abdomen.

No. 17. *Animal: hare.*—Etherized; laparotomy middle line. The jejunum was exposed as in previous case, and in addition to making a perforation in the bowel wall (half dividing the bowel transversely across) an omental graft was sutured over the perforation. The wound itself was left unclosed. The animal was very quiet after operation, and died seven hours later. Post-mortem showed abundant exudate, thick and bile-stained, generalized throughout the peritoneum. It closely resembled the fluid seen in cases of ruptured duodenal ulcer. The omental graft was not firmly adhering at any point to or around the perforation where it had been attached. Contents in peritoneal cavity.

No. 26. *Animal: hare.*—October 15, 1916: Etherized; laparotomy middle line. Stomach exposed. Wound made in the middle of the anterior surface of the stomach wall at the junction of the cardia and pyloric canal. The wound was made in the transverse axis of viscus and the perforation was large enough to admit a pea. A small amount of fluid contents leaked out at the time of operation. Stomach was full at the time of operation. Post-mortem showed no general food extravasation, but a local collection not much more in quantity than was noticed at operation. There was a very marked general peritonitis present.

No. 27. *Animal: cat.*—October 16, 1916: Laparotomy. Small gut (lower ileum) three parts divided across transversely. Loop returned into small part of peritoneal cavity from which it came. On the following day it looked well, but ate nothing and remained quiet. Animal died fifty-six hours after operation. Post-mortem showed an acute general

peritonitis. There was no food extravasation of any kind; all intestines collapsed.

No. 30. *Animal: hare.*—October 18, 1916: Etherized; laparotomy. Wound made in the duodenum. The incision in the bowel wall was big enough to admit the nose of a pair of Spencer Wells artery forceps. Some bile-stained fluid escaped at the time the incision was made. October 19: Animal not well; not eating, very quiet. Died thirty-two hours after operation. General peritonitis; much contents all over the abdominal cavity.

No. 32. *Animal: cat.*—October 20, 1916: Etherized; laparotomy middle line. Animal had a large meal of meat just previous to the operation. Wound made in the ileum (lower end). The wound in this case was a large transverse one dividing the bowel three parts across. Loop replaced in the right iliac fossa. Immediately the bowel was divided the loop at the point of incision became markedly stenosed, completely blocking the lumen of the gut. There was very little eversion of the mucous membrane. October 22: Animal well; quiet, not eating. October 23: Animal much better; has eaten bread and milk. October 25: Continues to improve; quite recovered.

No. 37. *Animal: cat.*—November 14, 1916: Etherized; laparotomy middle line. Jejunum divided three parts transversely across. The loop taken was a point four inches from the upper fixed end of the bowel. November 15: Animal looks well; not eating. November 16: Animal looks very bad indeed. November 17: Animal died fifty-six hours after operation. Post-mortem showed a general peritonitis with bile-stained fluid throughout the peritoneum.

No. 40. *Animal: cat.*—November 20, 1916: Laparotomy middle line. Wound made in the large bowel (in middle of colon). The wound was a transverse one half dividing the bowel across. Gut replaced into abdomen. There was no hæmorrhage and no escape of gut contents followed the production of the wound. Animal died twelve hours later. Post-mortem showed localized peritonitis with very dirty fluid in the neighbourhood of the wound loop. The surrounding coils of small intestine were deeply injected. There was scarcely any spread of fæcal matter from the bowel.

No. 41. *Animal: cat.*—November 20, 1916: Colon wound made as in previous case. The site of the large intestine was the upper part of the rectum. The wound was transversely made to the axis of the bowel; loop replaced in abdomen. November 21: Animal looks well, is quiet; not eating. Later in the day she showed signs of "general weakness" and died twenty-nine hours after operation. Post-mortem showed a large amount of dirty fluid in the lower abdomen. No local extravasation of fæcal matter.

No. 42. *Animal: hare. Wound of Ileum.* December 28, 1916: Laparotomy in middle line. Loop of lower ileum half divided transversely across and gut returned into abdomen. December 29: Animal quiet; has eaten nothing. December 31: Complete recovery. January 17: Examination of wounded coil showed it to be free in the peritoneal cavity. The only sign of the lesion was a small raised nodule in the line of the intestinal wound, chiefly involving the peritoneum.

No. 43. *Animal: hare. Wound of Jejunum.*—December 28, 1916: Laparotomy performed in middle line. An upper loop of the jejunum was half divided across. No escape of intestinal contents occurred at the operation. The animal died twelve hours later. Post-mortem showed general peritonitis.

Table of Experiments.

Large wounds of the lower ileum ..	4 ..	2 died, 2 recovered.
Large wounds of the duodenum and jejunum	5 ..	5 died.
Large wounds of the stomach	1 ..	1 died.
Large wounds of the colon	2 ..	2 died.

Paragraph 3.—The Behaviour of Omentum to Perforating Wounds of the Intestine.

The behaviour of the omentum is of great clinical interest and its value in various abdominal conditions has long been recognized.

We have attempted to analyse the behaviour of the structure when there is a wound of the abdominal hollow viscera. Clinically we have repeatedly made the observation that, in perforating wounds of the intestine, the omentum does not, primarily at least, come in contact with the injured gut. On the other hand, if the wound has not actually perforated the viscus, but has merely damaged and bruised its wall, the omentum migrates to the injured part and puts itself in such a position that it tends to prevent any further spread of infection. The second of these clinical facts is well illustrated by the following history:—

Pte. A. B. was struck by a fragment of shell on the left side immediately behind the great trochanter. The missile passed deeply across the buttock and passed out on the same side close to the middle line. There was intense local sepsis, to which the patient succumbed five days after the receipt of the injury. During the post-mortem examination it was found, on opening the abdomen, that the omentum was firmly adherent in the pelvis, shutting off and localizing a bruised necrotic area of the upper rectal wall. The projectile had not opened the peritoneal cavity, but somehow by its passage it had bruised and devitalized the gut wall. Now had there been a perforation of the gut of any size, we

believe the omentum would not have migrated to the injured part, but, being a non-perforating injury, its localizing effect came into play.

There are several possible explanations of such actions of the omentum.

(1) It has been suggested that perforation of the gut has been followed by a temporary paralysis of the intestinal tract, and that this paralysis prevents the omentum from being moved to the injured site.

(2) The second suggestion is that when the gut is perforated the local infection is so great that it acts upon the omentum, so to speak, as a negative chemiotaxis, repelling the omentum. On the other hand, when the gut is merely bruised, a positive chemiotaxis is induced and the omentum is attracted to the injured spot.

A definite answer can only be given when there is a definite solution to the question as to how the omentum finds its way about the peritoneal cavity.

As we have said, we have observed clinically that in perforating wounds of the intestine the omentum is not at the site of the injury, but is lying as a double barrier across the upper part of the abdomen. In all probability this position is taken up in order to form a barrier between healthy and affected peritoneum, and so prevent a further spread of sepsis into the upper and more delicate part of the peritoneal cavity.

Experimentally, we have demonstrated the following facts: When bruise-wounds of the intestine are made without actual perforation, the omentum is found to come down to the lesion and to aid in its immediate repair. The same procedure occurs when areas of the gut are devascularized.

In perforating wounds of the gut the omentum behaves differently. If, when the wound is made, the omentum is laid over the injured gut, it remains in this position and therefore takes some share in the subsequent repair. If, however, the omentum is not brought to the site of injury, it made no spontaneous effort to make its way there, but remains as a transverse barrier in the upper abdomen.

When the omentum is brought to the site of injury, its greatest benefit will be derived if it is anchored in this position with a few sutures. There are portions of the intestinal tract in which an omental graft, such as has been described, is useless. In the case of unsutured large wounds of the duodendum and upper jejunum (and certain parts of the large intestine ?) central grafts, even when fixed in position, are of little use. Apparently the omentum has little control over the intestinal juices of the upper end of the small gut.

It is interesting to record that we found the omentum capable of replacing a portion of resected stomach wall. The animal made a good recovery (see experiment No. 31 and fig. 1).

Summary.

(1) Omentum will spontaneously hasten to repair a bruised non-perforating wound of the intestinal tract.

(2) Omentum will take no spontaneous action in dealing with a perforating wound of the intestinal tract.

(3) When omentum is specifically laid over a perforating wound of the gut and preferably fixed there with sutures, it plays an important part in limiting infection and in hastening repair.

(4) When the duodenum and upper jejunum are perforated, omental grafts are of little value. Their salutory action appears to be prevented by the intestinal juices of the high small intestine.

(5) In gunshot perforating wounds of the intestine the omentum is generally found arranged as a barrier along the line of the transverse colon, and so shutting off the lower from the upper abdomen.

Protocol of Experiments (relating to Paragraph 3).

No. 2. Animal: hare.—Etherized; laparotomy. Appendix pulled up and half divided transversely across. Replaced into peritoneal cavity and the abdomen closed. The omentum was not seen at the operation. Seven hours later laparotomy was performed. There was a generalized peritonitis with a thin purulent exudate. The omentum had not come down to the site of injury, but lay well up in the upper abdomen.

No. 3. Animal: hare.—Etherized; laparotomy. A loop of the upper jejunum was divided half across transversely. Omentum laid over the injured loop, without the application of sutures. Abdomen closed. Seven hours later the abdomen was re-opened and the wounded loop lay in the same position still covered by the omentum, but not firmly adherent to it.

No. 4. Animal: hare.—Etherized; laparotomy. A loop of upper ileum was half divided across and replaced into the abdomen. The omentum was laid over the wounded loop. The abdomen was closed and re-opened five hours later. The injured loop lay where it had been replaced in the peritoneal cavity. The omentum lay adherent to the wound in the same position as it had been placed five hours previously.

No. 6. Animal: hare.—Etherized; median laparotomy. Three small perforating wounds made in the upper ileum, two inches of bowel existing between each perforation. The typical eversion of mucous membrane was seen and a small amount of intestinal contents escaped. Omentum laid over the wounded loop. Recovery uneventful. Eleven days later the abdomen was re-opened. The wounded loop was adherent to other loops of small intestine, and to the three perforations small tags of omentum adhered showing fine leashes of vessels running on to the peritoneal coat of the bowel.

No. 7. *Animal : hare.*—Etherized ; median laparotomy. Loop of jejunum wounded by making a longitudinal cut in the bowel ½ inch in length. The omentum was laid over the wound and the abdomen closed. Nine hours later the abdomen was reopened. There was a marked general peritonitis with extravasation of small gut contents throughout the peritoneum. The omentum no longer lay in contact with the wounded coil of jejunum but near to it.

No. 8. *Animal : hare.*—Etherized ; median laparotomy. Lowest loop in ileum wounded. Three perforations made in the same loop, each presenting prolapse of mucous membrane. The omentum in this case was not seen. Abdomen closed ; recovery uneventful. Laparotomy nine days later showed signs of an old general peritonitis, firm adhesions existing between the wounded loop of gut and the other coils of the small intestine. The omentum was not adherent to the perforations.

No. 9. *Animal : hare.*—Etherized ; laparotomy. A longitudinal incision was made in the lower ileum ½ inch in length. Very little escape of intestinal contents was noticed at the time of injury. The omentum was not in the neighbourhood and was not brought over the wounded gut. Belly closed. The animal died fourteen hours later. Post-mortem showed acute general peritonitis with local food extravasation. The omentum lay away from the wounded coil and had not come to the site of injury.

No. 17. *Animal : hare.*—Etherized ; laparotomy. The upper jejunum was wounded by dividing the bowel half transversely across. Omentum tacked on to the jejunum around the wound of the gut by four sutures. Bowel replaced in abdomen. The animal died seven hours after operation. Post-mortem showed a general extravasation of gut contents throughout the peritoneum. The omental graft had not adhered to the wounded jejunum in spite of the Lembert sutures attaching it over the wound.

No. 19. *Animal : dog.*—Etherized ; median laparotomy. The lowest loop in the ileum was divided half across transversely. A graft of omentum was sutured by Lembert stitches over the wide gaping wound. Coil of gut replaced into abdomen. Recovery uneventful. Two weeks later the animal was in perfect health and had lost no apparent weight. Animal killed. Post-mortem showed the omentum graft to be firmly adherent around the wound in the ileum. There were no general adhesions in the peritoneal cavity. After hardening the specimen in formalin, an examination was made from the inner aspect of the bowel. It showed a well punched-out ulcer, the size of a sixpence, the base of which was formed by the omentum covered over by a thin layer of mucous membrane (see fig. 2).

No. 23. *Animal : dog.*—Etherized ; laparotomy. Loop of upper jejunum half divided transversely across. A graft of omentum was sutured by Lembert stitches over the wound in the gut which showed well the

prolapse of mucous membrane. The bowel appeared to be empty and there was no escape of intestinal contents at the time of the operation. Loop replaced in abdomen. The animal died thirty-six hours later. Post-mortem showed a general peritonitis with considerable extravasation of slightly bile-stained viscid fluid. The omental graft had become separated from the gut and a portion of it showed a patch of gangrene. The graft was not adherent to any part of the jejunum except at the points of the Lembert sutures.

No. 31. *Animal: dog.*—Etherized; laparotomy. Median laparotomy; portion of the anterior stomach wall was removed. The resected portion measured $\frac{3}{4}$ inch by $\frac{1}{2}$ inch. The wound in the stomach admitted the tips of three fingers and showed marked prolapse of mucous membrane. The omentum was sutured loosely by Lembert stitches to the peritoneum around the resected portion of the stomach. Abdomen closed. Recovery was straightforward. The animal lost no weight and was well a month later, when it was killed for examination. At the post-mortem examination the stomach, with over-lying attached omentum, was adherent to the anterior abdominal parietes in the line of the laparotomy incision. On separation of the omentum from the abdominal wall, it lay attached to the stomach wound, having much the same appearance as seen at the operation. The interior of the stomach showed a small round ulcer having the appearance of a healed "chronic gastric ulcer." The base was the size of a threepenny bit and was continuous with the normal surrounding mucosa (see fig. 1).

No. 32. *Animal: cat.*—Etherized; laparotomy. Lower ileum wounded. Gut was divided half transversely across and replaced in peritoneal cavity. The omentum was laid over the wound in the bowel without sutures. Recovery uninterrrupted. Animal killed for examination four days later. Post-mortem showed no peritoneal adhesions; there was a tag of omentum adherent to the wound in the bowel. It was easily separated and the gut contents immediately escaped on undoing the omental adhesion.

No. 21. *Animal: hare.*—Etherized; laparotomy. Wound made in stomach $\frac{1}{2}$ inch in length in anterior wall of cardia. Graft of omentum sutured over the perforation by Lembert sutures through the adjacent peritoneal coat of stomach. The actual perforation in the stomach wall was not closed. The gaping mucosa could easily be seen shining through the thin omental covering. Animal made a straightforward recovery. Killed for examination three weeks later. Post-mortem showed dense adhesions of omentum around the perforating wound. From the inner aspect of the viscus a small healed ulcer was seen (see microphoto. No. 1).

Paragraph 4.—Mode of Repair in Intestinal Wounds which Undergo Spontaneous Recovery.

It appeared to us to be of interest to know the exact details of repair in perforating intestinal wounds which recover spontaneously. Belgian hares were employed in the various experiments. Perforating wounds were reproduced by cutting the bowel wall with fine scissors. Eversion and prolapse of the mucous membrane inevitably occurred. Subsequent observations were first made twenty-four hours later. There was found to be a gluing together of the intestinal coils in the neighbourhood of the lesion. It was remarkable that in every case the general peritoneal cavity was unsoiled.

If the injured bowel at the time of the experiment is covered with omentum, interesting results were observed. At the end of twenty-four hours the omentum remained extensively glued over the injured site. It remarkably limited the infection, and there was very little evidence of inflammation of the surrounding gut. The affected and the neighbouring coils of gut were somewhat distended and if the omentum was separated from the gut there was immediately a profuse escape of intestinal contents.

Three days after the original operation, the relationship of the omentum to the injured gut had altered. The gut was free except at the actual point of injury. At each of these, a tag of omentum firmly sealed off each perforation (see fig. 3.) Separation of the omental tag showed little change in the actual gut-wound. The mucous membrane was prolapsed and showed a slightly fibrosed appearance. Separation of the omental tag was at once followed by escape of intestinal contents.

Examination one week after the original operation showed the omentum adherent only at the points of perforation of the gut. The omentum was firmly adherent to the gut and a vascular anastomosis could be traced in the shape of leashes of fine vessels passing between the omentum and the bowel wall.

On separation of the omentum, the rosette of prolapsed mucous membrane was no longer visible, but the situation of the prolapse was occupied by a plug of yellow fibrin which blocked up each perforation. In certain colon wounds the fibrin plug was found to contain large Gram bacilli of the perfringens type (see fig. 4, microphoto. 2).

Wounds examined at a later date showed varying changes. It would appear that during the second and third weeks there is a tendency for sacculation of the mucous membrane to occur at the site of injury. This was especially evident in Experiment 13. The lower ileum had been wounded, and the lesion covered with omentum. Twenty-two days later the lesions were found closed by firm omental adhesions. At each point of injury there was a distinct hernia of the mucous membrane through the

gap in the muscular wall of the gut into the overlying omentum. This experimental fact is interesting, because it so closely bears out the following clinical findings:—

Pte. A. L. was shot through the abdomen by a rifle bullet in September, 1915. He was not operated on, and he was eventually evacuated to England, where he underwent a prolonged convalescence. He eventually returned to duty in France, and he was again shot in the abdomen in June, 1916. On this occasion he was admitted to hospital under the care of Capt. G. Bell, R.A.M.C., to whom we are indebted for the notes of the case.

At the operation very extensive and old-standing adhesions were found all over the abdomen, making complete examination of the small gut extremely difficult. At irregular intervals over several feet of small intestine signs of previous damage were found in the shape of numerous finger-like processes which seemed to consist of mucosa alone, and to be herniating through the gaps in the muscle coats. Between two adjacent cells there was at one point a miniature entero-enterostomy, the lumen of which admitted a stout probe.

Though there can be no doubt that such a case as this is extremely rare, yet it illustrates the possibility, and, to some extent, the method of spontaneous cure of small intestinal wounds. We would add that the rarity of such a case must be so great that its occurrence ought in no way to modify the present accepted rule of immediate operation.

We have always drawn attention to the power and the value of the omentum as a means of aiding spontaneous cure of intestinal wounds.

Experimentally we record a case of spontaneous cure of a stomach wound when the cure was entirely dependent upon the omental graft employed.

In the anterior wall of a rabbit's stomach, a wound $\frac{1}{2}$ inch long was made. The wound was covered with an omental graft, lightly sutured in position. No sutures were inserted into the actual stomach wound. Three weeks later the omentum was found firmly adherent to the wound. The interior of the stomach showed a small round pit-like depression, not unlike a healed gastric ulcer. Microscopical examination showed that the gap in the stomach wall was closed by a thin layer of dense cicatricial fibrous tissue, formed partly from the peritoneal coat, but chiefly from the portion of the omentum which was grafted over the wound. The inner aspect of the layer had no epithelial lining, but was covered with a thin layer of necrotic tissue slightly invaded by leucocytes. The cut edges of the mucous membrane had been drawn outwards by cicatrization over the cut edge of the muscular coats, closely simulating the condition of a chronic gastric ulcer.

Summary.

(1) In the absence of omentum spontaneous closure of intestinal wounds occurs by adhesion of neighbouring coils of intestine with a plastic peritonitis.

(2) Spontaneous closure is hastened when omentum is brought into contact with the injured part.

(3) The omentum is at first widely adherent over the injured part. At the end of three days the points of adhesion are limited to the actual gut perforation. At the end of seven days a vascular anastomosis has occurred between omentum and gut wall.

(4) Mucous membrane at the point of injury remains prolapsed for about a week, in this way to some extent blocking up the aperture. It is eventually replaced by a plug of fibrin.

(5) At the site of perforation there tends eventually to be a small sacculation of the mucous coat through the unsupported gap in the muscular tissue.

(6) Large areas of stomach wall can be replaced by omental tissue, but restoration of the stomach epithelium does not appear to occur.

Protocol of Experiments (relating to Paragraph 4).

No. 18. Animal: hare.—Etherized; laparotomy. Uppermost loop of jejunum perforated at three separate sites; one inch interval between each perforation. The gut at the time of injury contained little intestinal contents, and only a trace of bile-stained fluid escaped from each wound. Examination three days later. The injured loop was free in abdominal cavity, with the exception of a tag of omentum, which adhered to each perforation. The omental adhesions were easily separable from the gut. The perforation then showed little change to the naked eye. The prolapsed mucous membrane looked slightly more fibrous, and bile-stained fluid escaped from the bowel. When the omental tags were separated from the wounds, each wound showed the typical small yellow fibrin plug.

No. 24. Animal: hare.—Etherized; middle line laparotomy. A small perforating wound made in rectum; small amount of prolapsed mucosa. The recovery was uneventful. On examination seven days later, the wound in the rectum showed a small vascular scar covered by peritoneum, a definite gap still remaining in the muscle coats of the bowel wall. There were no definite adhesions between the rectum and other part of the bowel.

No. E 15. *Animal: hare.*—Etherized; laparotomy. Two small perforations made in the lower ileum. Typical eversion of mucosa produced. On examination seven days later, a yellow plug of fibrin covered each perforation. The omentum in this case was not adherent to the site of

injury. The loop was perfectly free in the abdominal cavity. Regeneration of peritoneum over the fibrin plugs.

No. 25. *Animal: hare.*—Etherized; middle line laparotomy. Wound made in cæcum large enough to introduce a goose quill; no extravasation seen at the time of injury, and there was little pointing of the mucous membrane. The animal was examined eight days later. The cæcum showed a thin newly-formed layer of peritoneum over the wound. There appeared to be a considerable gap in the muscle fibres at the site of injury, but no hernial protrusion had yet formed.

No. 8. *Animal: hare.*—Etherized; median laparotomy. Three perforations made in the lower ileum producing eversion of mucous membrane in each case. The gut was collapsed and there was little intestinal escape at the time of injury. Recovery straightforward. Nine days later examination of the injured loop showed marked adhesions to other loops of small gut and to the anterior belly wall, especially at the points of perforation. On separation of the adhesions, the wounds showed gaps in the muscle coats, but no definite hernial protrusions. There appeared to be a definite new lining of peritoneum.

No. 13. *Animal: hare.*—Etherized; laparotomy. Three perforations made in lower ileum. Omentum laid over the wounded coil. Recovery uneventful. Animal killed twenty-eight days after operation. Wounded coil was recognized in abdomen by the adherent tags of omentum at site of perforation. The omentum had evidently made traction on the loop as it showed a distinct tendency to saccular formation at the points of perforation (see microphoto. 3).

No. 11. *Animal: hare.*—Etherized; middle line laparotomy. Two small perforations made in the colon producing eversion of mucous membrane. One perforation made through the circular fibres between the longitudinal bands. The other was made through a longitudinal band of muscle. The omentum was laid over the colon but not sutured to the bowel. Recovery straightforward. Examination twenty-four days later showed a mass of omentum adherent to the colon at the point of perforation, forming a tumour the size of a small hazel nut. On section, the mass contained caseous material showing an old communication with the bowel through one of the perforation wounds. From the inner aspect of the bowel a small pit-like depression existed, leading into the caseous mass. A film examination of the caseous material shows large Gram bacilli of the perfringens type. The other perforation showed a similar caseous mass with adherent omentum much smaller in size.

No. 12. *Animal: hare.*—Etherized; middle line laparotomy. The colon was wounded in two places. An examination of the bowel one month later showed small yellow caseous bodies the size of No. 4 shot, one over each perforating wound; the peritoneum showed definite regeneration,

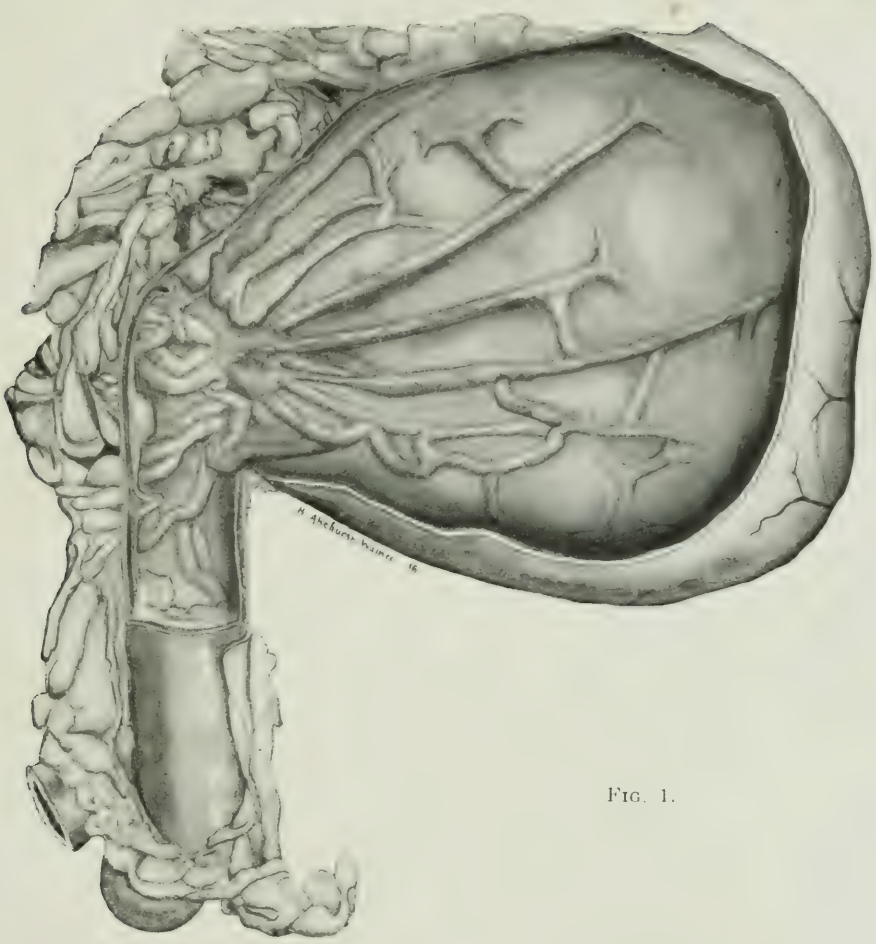

FIG. 1.

FIG. 2.

To illustrate "Some Experimental Observations on Perforating Wounds of the Abdominal Viscera," by Captain HAMILTON DRUMMOND and Captain JOHN FRASER.

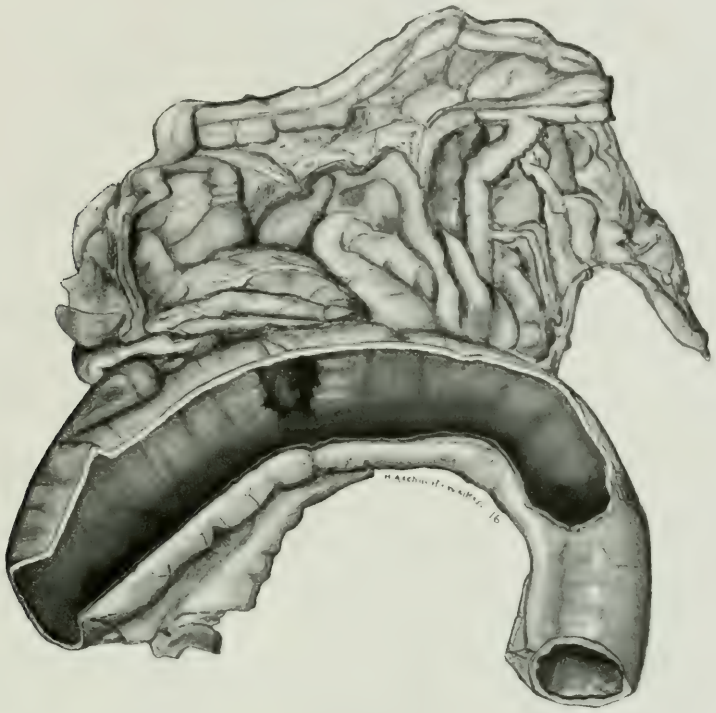

FIG. 3.

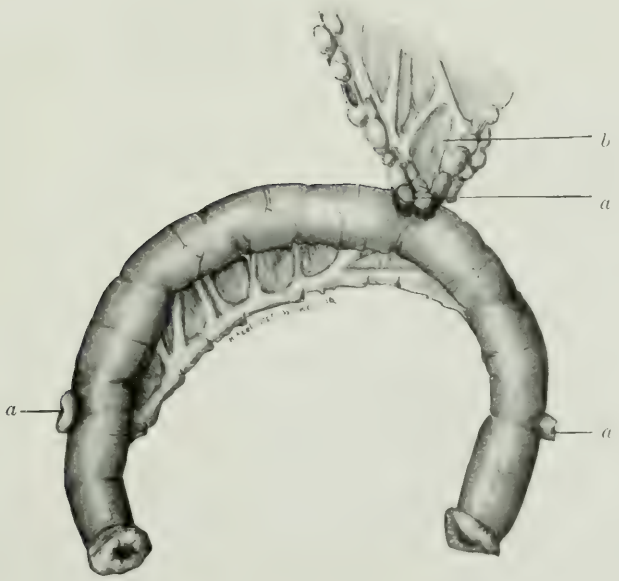

FIG. 4.

To illustrate "Some Experimental Observations on Peforating Wounds of the Abdominal Viscera," by Captain HAMILTON DRUMMOND and Captain JOHN FRASER.

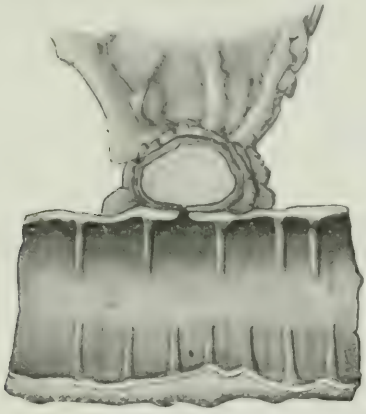

FIG. 5.

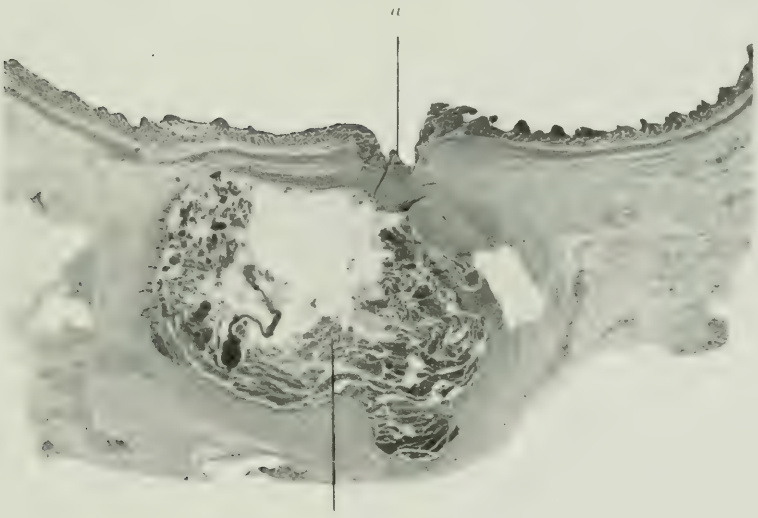

FIG. 6.

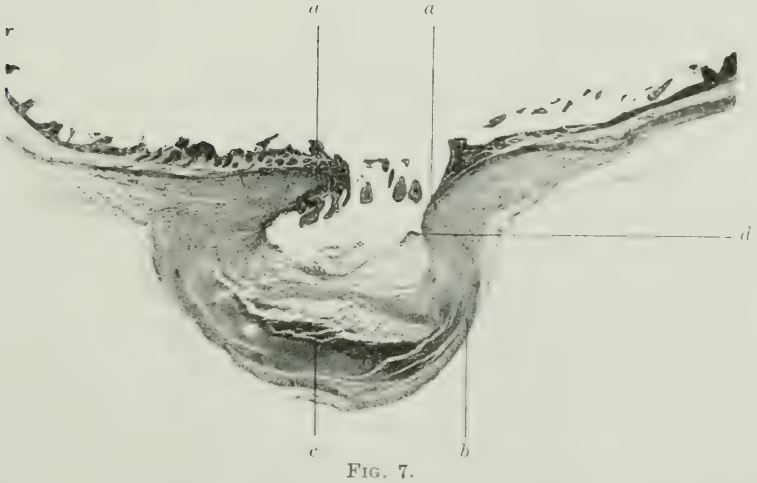

FIG. 7.

To illustrate "Some Experimental Observations on Perforating Wounds of the Abdominal Viscera," by Captain HAMILTON DRUMMOND and Capitain JOHN FRASER.

but not the muscle coats. No adhesions existed between the colon and other loops of gut.

We wish to acknowledge our indebtedness to Colonel Wallace, A.M.S., for his encouragement and esteemed advice, to Lieutenant-Colonel Winder, R.A.M.C., and Lieutenant-Colonel Frankau, R.A.M.C.(T.), for permission to investigate the subject, and to Captains Macnee and Dunn of No. 3 Mobile Laboratory, for the courtesy they have shown us, and the repeated assistance they have given us in carrying out these experiments.

DESCRIPTION OF PLATES.

FIG. 1.—(*Drawing.*)—Specimen shows the interior aspect of the stomach of a dog. A portion of stomach wall was excised, measuring $\frac{3}{4}$ inch × $\frac{1}{2}$ inch. The gaping wound was left unsutured and a graft of omentum sutured to the adjacent healthy stomach wall by Lembert sutures: normal recovery. Examination a month later showed the wound to be completely healed by the omentum. The wound from the inner aspect showed considerable cicatrization and a healed ulcer the size of a threepenny piece, the base of which was formed by the omentum, covered by a layer of stomach mucosa.

FIG. 2.—(*Microphotograph.*)—Omental graft overlying unsutured stomach wound. (See Experiment 21, Hare.) The gap in the gastric wall has been closed by a thick layer of dense cicatricial fibrous tissue *a*, formed partly from the peritoneal coat and partly from the portion of omentum which was grafted over the wound. The inner aspect of this layer has no epithelial investment, but is necrotic and invaded by leucocytes. This exposed surface is of considerable extent, coinciding in size with the gap between the cut ends of the muscular tunic (*b*, *b*). The cut edges of mucous membrane (*c*, *c*) have been drawn outwards by cicatrization over the cut edges of the muscles, so as to simulate the condition in a chronic gastric ulcer.

FIG. 3.—(*Drawing.*)—Specimen shows the inner aspect of the lower end of the ileum of a dog. The bowel was half divided transversely across, producing a typical bullet wound; an omental graft was sutured over the wound without closure of the actual wound in the gut. Straightforward recovery followed. Examination two weeks later showed the omentum firmly adherent over the wound in the gut. The interior aspect of the bowel showed a well-marked punched-out ulcer, size of a sixpence, the base of which was covered by a thin layer of mucous membrane. See Experiment 19.

FIG. 4.—(*Drawing.*)—Specimen shows a loop of small intestine of a hare with three small perforations which underwent spontaneous cure. Each perforation shows a typical rosette of prolapsed mucous membrane (*a*, *a*, *a*). In this case (three days old) the loop lay free in the peritoneal cavity with a tag of omentum (*b*), adherent to each perforation.

FIG. 5.—(*Drawing.*)—Specimen shows perforating wound of the colon of a hare which underwent spontaneous recovery. Twenty-four days later a sac overlay the perforation with a wall of newly-formed fibrous tissue. The omentum adhered firmly to the walls of the sac surrounding the perforation.

FIG. 6.—(*Microphotograph*).—Perforating wound of colon which underwent spontaneous cure (Experiment 11, Hare.) The mucous membrane immediately round the narrowed aperture (*a*) is fibrosed and free from glands, and its epithelial covering is thin. There is a large sac with a wall of newly-formed fibrous tissue outside the bowel at this point (*b*). It is lined by granulation tissue, and contains necrotic debris, with organisms and leucocytes. The inflammatory changes are of quiescent type.

FIG. 7.—(*Microphotograph.*)—Perforating wound of the ileum, twenty-three days old, which underwent spontaneous cure. (Experiment 13, Hare). On microscopic examination, a wide gap is seen to persist between the original cut ends of muscular and mucous layers (*a*, *a*), and the repair which has been effected is due to the development of a thin layer of fibrous tissue from the peritoneal coat (*b*). This layer evidently bulges outwards, so as to form a saccule, and the hollow of the saccule is partially filled by a thick mass of fibrinous and necrotic material, infiltrated by leucocytes (*c*). The mass of dead material, which probably sealed the wound at a very early stage, is undergoing organization by ingrowth of vessels. It is also becoming covered in by a layer of columnar epithelium (*d*), extending out from the surface of the mucosa.

THE LATE APPEARANCE OF AGGLUTININS IN PARATYPHOID A FEVER.

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(*A Report to the Medical Research Committee.*)

In some recent reports on work in connexion with the behaviour of agglutinins in the paratyphoid fevers, especially in subjects inoculated either with anti-typhoid or the triple vaccine, certain observations have been made which were considered to point to the somewhat erratic course of these agglutinins, and which have accordingly been classed as anomalies. During the course of over 1,200 routine serological investigations in obscure pyrexias, cases of jaundice, and convalescent fevers of the enteric group in patients from Mesopotamia, certain of those anomalies have presented themselves. An opportunity has been afforded of attempting their elucidation through the occurrence of a number of acute cases, mostly all paratyphoid A fevers, which have been kept in this hospital over a prolonged period for "clearing" purposes. It has thus been possible to study the variation in the agglutination curve by blood examinations repeated at frequent intervals till the twelfth or fourteenth week of convalescence, and in some instances to the eighteenth and twentieth weeks, and certain phenomena have been observed which seem to go far to explain some of these anomalous findings. The investigations on several of the questions are still incomplete, but sufficient evidence has accumulated to justify the publication of the findings in regard to the extremely late appearance of the agglutinins in many cases of paratyphoid A fever. So delayed has been the response of these agglutinins in many instances that doubts are raised as to whether one can with any confidence attempt to draw a conclusion as to the special type of an "enterica" infection at any period during a pyrexia of three weeks' duration, or even before the thirtieth day from the onset of the fever. The importance of this conclusion has been repeatedly borne in upon us on comparing the deductions drawn from our own agglutination tests with those carried out in Mesopotamia at an earlier and more acute stage of the fever. For example, in quite a number of convalescent "enterica" infections which were admitted as "typhoid fever" on the diagnostic basis of an agglutination test which had been positive to *Bacillus typhosus* and completely negative to para A and para B we found on doing a series of Widal reactions after the twenty-eighth day from the commencement of the fever and onwards into late convalescence that para A agglutinins were distinctly present.

Dreyer [1] has pointed out that in the initial stages of paratyphoid A

fever the agglutination titre is very low, and that it may easily lead to a negative diagnosis unless the test is carried out with low dilutions of 1 in 20 or less of the serum. Walker Hall [2] cites two cases in which para A bacilli were isolated from the blood but no para A agglutinins were identified, even when the low dilutions recommended by Dreyer were used. It is however noted that the inoculation agglutinins showed variations in each case. No figures however are given for those cases, so that we are unable to determine whether the agglutination tests were carried on into convalescence. In 1911 Grattan and Wood [3] described how in paratyphoid fever the agglutinins of para A bacillus were preceded by a rise in *B. typhosus* agglutinins in persons who had been inoculated with *B. typhosus* vaccine. They concluded that an inoculated man suffering from paratyphoid fever, the original agglutination titre of his serum to *B. typhosus* due to his inoculation rises about the eighth day and reaches its maximum about the eighteenth. Thereafter it declines during the next three months, while the agglutinins for paratyphosus A do not appear much before the twelfth day, reach their height about the twenty-fourth day, and totally disappear within two months. Attention to this preliminary rise in *B. typhosus* agglutinins has recently been redirected by Martin and Upjohn [4]. These workers have also observed the appearance of para A agglutinins in the third, fourth, and fifth weeks, and have noted the fact that unless their investigations had been persisted in, numerous paratyphoid cases would have been diagnosed as typhoid fever. These observations have been confirmed during the course of the present work, and have been considerably extended in that agglutination tests have been performed as late as the twentieth week from the commencement of the fever, whilst the agglutinins have in all cases been worked out to their end-points. Several cases are also recorded below in which there was a typical enteric temperature, symptoms—rose spots, etc., associated with a mild toxæmia, and in which the agglutination tests as late the fifteenth day were persistently negative even in low dilutions of the serum. On continuing the agglutination tests into convalescence in spite of the completely negative results during the first two weeks, para A agglutinins appeared by the twenty-first day and were still present at the eleventh week. The possible influence of inoculation with the antityphoid and T.A.B. vaccines in leading to this delayed agglutinin response has also been investigated.

Technique Adopted.

The agglutination method used has been Dreyer's macroscopic method, slightly modified, the dilutions used being 25, 50, 100, 200. The agglutination of every serum has been worked out to its end-point, each series of dilutions being ten times greater than the one preceding, e.g., the second series being 250, 500, 1,000, 2,000, and so on. In a number of cases lower dilutions of para A were put up, as had been suggested by Dreyer. Sterile

TABLE I.—Agglutination Titres of Cases inoculated with T.A.B.

No. of case	Name	Weeks since inoculation	Nature of inoculation	Duration of pyrexia	Organism isolated		Week of Disease. (Titre expressed in agglutinin units)																	
							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Prinn	26	T.V.	4 weeks	Para A	T.	0	125	..	357	400	400	40	..	225	20	20	..	..	20	40	40	.	..	..	..
		13	T.A.B.		(blood	A.	0	15	..	715	715	2860	1387	..	30	15	15	..	..	15	7	7	..	..	..	..
					and	B.	0	0	..	0	0	0	0	..	0	0	0	..	..	0	33	33	..	..	..	..
					fæces)																					
2	H. Price ..	10	T.A.B.	2 weeks	Para A	T.	82	1000	..	25	..	..	..	40	..	400	..	..	40	..	40	..	..	..	..	..
					(blood	A.	7	70	..	280	..	..	..	70	..	280	..	..	14	..	35	..	..	..	..	..
					and	B.	40	40	..	0	..	..	..	0	..	20	..	..	30	..	30	..	..	..	..	..
					fæces)																					
3	Snape ..	30	T.A.B.	1 week, followed by relapse on 24th day	..	T.	0	0	10	..	..	100	100	..	100	..	10	..	40	..	22	..	..	..	..	..
						A.	0	100	22	..	..	1150	1420	..	500	..	140	..	14	..	70	..	..	..	..	..
						B.	0	0	10	..	..	100	3125	..	62	..	62	..	30	..	30	..	..	..	..	..
4	Harris ..	16	T.A.B.	25 days	..	T.	..	0	..	0	..	250	100	..	..	..	60	..	..	60	..	120	..	..	..	..
						A.	..	0	..	0	..	14	140	..	..	..	7	..	..	0	..	0	..	..	..	..
						B.	..	0	..	0	..	0	0	..	..	..	0	..	..	0	..	0	..	..	..	..
5	Shipway ..	25	T.A.B.	12 days, followed by relapse 19th-26th days	..	T.	0	..	..	20	..	200	100	..	6	225	40	..	40	40	..	..	..	..	..	..
						A.	0	..	..	285	..	28	0	..	10	250	70	..	70	70	..	..	..	..	..	..
						B.	0	..	..	0	..	0	0	..	0	0	0	..	14	7	..	..	..	..	..	..
6	Orford ..	80	T.V.	3 weeks	Para A	T.	..	150	500	50	1000	..	100	..	50	100	..	..	..	..	..	..	..	..	..	..
		30	T.A.B.		(fæces)	A.	..	0	3	285	50	..	14	..	0	14	..	..	..	..	..	..	..	..	..	..
						B.	..	20	20	40	20	..	20	..	20	30	..	..	..	..	..	..	..	..	..	..
7	Pearce ..	30	T.A.B.	3 weeks	..	T.	..	..	40	..	..	400	..	200	..	130	100	..	50	..	150	..	150	..	..	..
						A.	..	..	20	..	..	55	..	284	..	715	142	..	142	..	284	..	28	..	..	..
						B.	..	..	40	..	..	0	..	40	..	60	80	..	120	..	60	..	300	..	..	..
8	Blake ..	20	T.A.B.	3 weeks	Para A	T.	..	..	80	..	800	..	100	..	50	..	100	100	142	..	28	..	..	..	..	..
					(fæces)	A.	..	..	250	..	355	..	510	..	510	..	145	250	580	..	58	..	..	..	..	..
						B.	..	..	20	..	20	..	0	..	0	..	0	0	0	..	0	..	..	..	..	..
9	Purcell ..	28	T.A.B.	Indefinite ambulatory case	..	T.	..	...	100	500	..	100	..	..	..	20	40	..	40	..	..	..	..	..	..	..
						A.	..	..	70	350	..	280	..	..	..	10	10	..	10	..	..	..	..	..	..	..
						B.	..	..	40	40	..	100	..	..	..	0	20	..	40	..	..	..	..	..	..	..

10	Weedan ..	65	T.V.	1 week	..	T.	..	50	..	50	0	..	..	180	..	..	..	225	..	..	..	125	30	..	..	22
		20	T.A.B.			A.	..	0	..	150	700	..	..	35	..	..	..	150	..	..	..	150	30	..	..	0
						B.	..	0	..	0	0	..	..	0	..	..	..	20	..	..	..	60	30	..	..	15
11	Bebb ..	20	T.A.B.	2 weeks	..	T.	..	..	..	..	..	360	..	450	..	..	..	45	..	..	..	..	90	45	..	..
						A.	..	..	..	..	..	10	..	720	..	..	..	420	..	..	..	..	25	16	..	..
						B.	..	..	..	..	..	0	..	0	..	..	..	0	..	..	..	..	15	15	..	..
12	Herd ..	28	T.A.B.	18 days	Para A	T.	..	12	100	..	100	..	12	..	44	..	12	..	50	..	..	..	..	..	..	..
					(fæces)	A.	..	3	28	..	28	..	14	..	28	..	14	..	8	..	..	..	..	..	..	..
						B.	..	4	15	..	15	..	15	..	30	..	30	..	30	..	..	..	..	..	..	..
13	Evans ..	20	T.A.B.	3 weeks	Para A	T.	..	50	..	50	..	100	..	25	..	150	..	15	..	70	..	30	..	100	..	..
					(blood	A.	..	70	..	70	..	700	..	280	..	280	..	560	..	560	..	280	..	180	..	..
					and	B.	..	60	..	15	..	15	..	60	..	30	..	60	..	60	..	90	..	120	..	..
					fæces)																					
14	Bond ..	132	T.V.	19 days	..	T.	..	44	55	55	..	..	44	..	55	..	55	55	..	..	..	..	..	..	..	..
		12	T.A.B.			A.	..	85	94	370	..	..	188	..	45	..	37	33	..	..	..	..	..	..	..	..
						B.	..	8	8	0	..	..	16	..	8	..	16	8	..	..	..	..	..	..	..	..
15	F. Smith ..	22	T.A.B.	14 days	Para B	T.	..	..	..	..	..	45	..	90	..	45	..	60	..	45	..	..	..	..	..	..
					(fæces)	A.	..	..	..	..	..	148	..	37	..	148	..	74	..	57	..	..	..	..	..	..
						B.	..	..	..	..	..	571	..	714	..	800	..	320	..	160	..	..	..	..	..	..
16	Lloyd ..	13	T.A.B.	4 weeks	..	T.	..	20	..	..	..	..	..	..	80	..	..	..	..	..	..	..	..	..	..	..
						A.	..	60	..	..	..	..	..	..	420	..	..	..	..	..	..	..	..	..	..	..
						B.	..	10	..	..	..	..	..	..	0	..	..	..	..	..	..	..	..	..	..	..
17	Coen ..	40	T.A.B.	6 weeks	Para A	T.	110	..	220	..	110	..	110	..	28	..	56	..	56	..	56	..	..	..	..	..
					(fæces)	A.	0	..	0	..	285	..	285	..	430	..	500	..	180	..	37	..	..	..	..	..
						B.	0	..	0	..	0	..	0	..	0	..	0	..	0	..	0	..	..	..	..	..
18	Kilshaw ..	16	T.A.B.	20 days	..	T.	..	0	..	11	..	44	..	44	..	..	44	..	..	..	..	..	..	..	..	..
						A.	..	0	..	28	..	284	..	142	..	..	10	..	..	..	..	..	..	..	..	..
						B.	..	0	..	0	..	0	..	15	..	..	8	..	..	..	..	..	..	..	..	..
19	Jones ..	72	T.V.	17 days	..	T.	..	222	..	22	..	55	..	55	..	55	..	..	..	..	..	..	..	..	..	..
		32	T.A.B.			A.	..	14	..	57	..	288	..	188	..	13	..	..	..	..	..	..	..	..	..	..
						B.	..	0	..	30	..	0	..	8	..	8	..	..	..	..	..	..	..	..	..	..

distilled water has been used instead of normal saline solution for the diluting of the emulsions to standard opacity. It has also been used as the diluent to make up to a constant the amount of fluid in the tubes containing the varying dilutions used in the performance of this test. This use of distilled water was found to quite materially reduce the "zones of inhibition" met with in the course of routine agglutination tests, a fact which was afterwards found to have been noted by Sladden [5]. The tubes were incubated for two hours at 50° to 55° C., and the readings were then made after the tubes had been allowed to stand a quarter of an hour. The majority of the readings, including any uncertain tests, were confirmed by a second observer, and were re-read after the tubes had stood over night. The emulsions have been made according to the method recommended by Dreyer, Walker and Gibson [6], from strains of bacilli originally isolated from patients invalided from Mesopotamia, and obtained through the kindness of Major Glen Liston, I.M.S., Parel Bacteriological Laboratory, Bombay. All the records are strictly comparable as the agglutinability of these emulsions has been controlled by comparing them with the emulsions issued by the Medical Research Committee, against the high-titre sera of the Lister Institute. The emulsion of *B. typhosus* and *B. paratyphosus* B has maintained the same agglutinability as that issued by the Medical Research Committee, while the para A emulsion has been one-third stronger than that sent from England. All the readings have been recorded in agglutinin units per cubic centimetre of serum, according to the method recommended by Dreyer. Blood was in all cases obtained from a vein in order to ensure of there being a sufficient amount of serum for repeated examinations and for tests in higher dilutions if required. The examinations were repeated as often as routine work would allow, and as often as samples of blood could be obtained. In a number of the cases it was possible to obtain blood during convalescence only after the lapse of a number of weeks, when the patients were once again in touch with the laboratory for "clearing" purposes. In the fourteen cases in which *B. paratyphosus* A, or *paratyphosus* B was isolated either from the blood or fæces the organism satisfied the recognized fermentation and serological tests. Unfortunately it was found impossible to carry out satisfactory absorption tests owing to the lack of adequate centrifuging facilities.

Analysis of the Results.

In Table I are grouped together nineteen cases which had been inoculated with T.A.B. vaccine at varying intervals before their attack of fever. Five of these patients had also been previously inoculated with typhoid vaccine (T.V.). The interval which had elapsed since inoculation is recorded in weeks, as is also the duration of pyrexia. All the figures refer to standard agglutinin units for each of the three organisms, *B. typhosus* (T), *B. paratyphosus* A (A), and *B. paratyphosus* B (B). In ten of the nineteen cases the pathogenic organism was recovered from the blood or the fæces. Para A was isolated from nine of those patients, while No. 15

is a case of pure para B infection in which *B. paratyphosus* B was isolated from the fæces. Of the others, from the series of agglutination tests all are considered to be para A infections except No. 3, which appears to be a mixed infection of para A and para B. It may here be noted that a number of para B infections have been detected in the routine examination of the numerous convalescent enterics, jaundices, P.U.O.s, etc., admitted from Mesopotamia, as well as in some "enterica" infections, occurring among the Turkish prisoners under treatment here.

Table II gives a record of the same details regarding thirteen cases which had been inoculated with T.V. only, and one case, No. 14, which had never been inoculated. From four of these, *B. paratyphosus* A was isolated, all the others from the agglutination results being also regarded as para A infections.

To discuss the salient features of the most interesting cases of Table I seriatim: In Case 1, graphically shown in Chart A, para A was isolated from the blood on the fourth day of fever, while no trace of the presence of agglutinins to any of the three organisms was detected although the patient had been inoculated with T.A.B. vaccine only thirteen weeks before. On the fourteenth day *B. typhosus* agglutinins were distinctly present, viz., 125 units as compared with para A fifteen units. By the fourth week paratyphosus A agglutinins were produced in large amount, viz., 715 units, and reached their maximum—2,860 units—during the sixth week, after which there was a rapid fall. Thereafter the agglutinins for *B. typhosus* and para A, remained steadily at a low level from the ninth to the sixteenth week. It is to be noted that the agglutinins for para B were altogether absent until during the fifteenth and sixteenth weeks when they were detected in relatively small amount as compared with the average agglutinins due to inoculation. In this case be it noted that the organism was isolated from the fæces during convalescence as well as from the blood during pyrexia.

Case 2 (see Chart B) is interesting in that there is well shown the preliminary rise in *B. typhosus* agglutinins about the fourteenth day with a production of agglutinins amounting to 1,000 units and almost four times as high as the maximum recorded value for para A agglutinins. Here also *B. paratyphosus* A was isolated from the blood on the fourth day of pyrexia as well as from the fæces during early convalescence. About the tenth week there is a second increase of para A agglutinins to 280 units with a synchronous rise for *B. typhosus* to 400 units. No recognizable change in the clinical condition of the patient could be associated with this marked rise in agglutination titre.

Case 3 appears to be a dual infection of para A and para B; the maximum production of agglutinins occurring for both about the sixth to the eighth week. A relapse with fever occurred on the twenty-fourth day. Unfortunately in this case we were unsuccessful in isolating any organism.

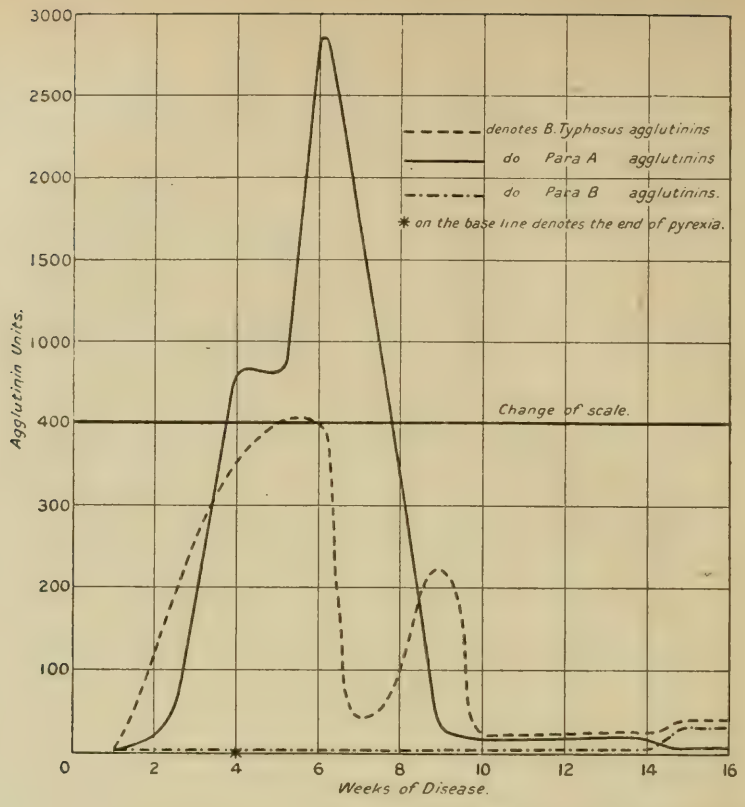

CHART A.—Prinn (see Table I, No. 1). Inoculated T.V. and T.A.B. Para. A isolated from blood and fæces.

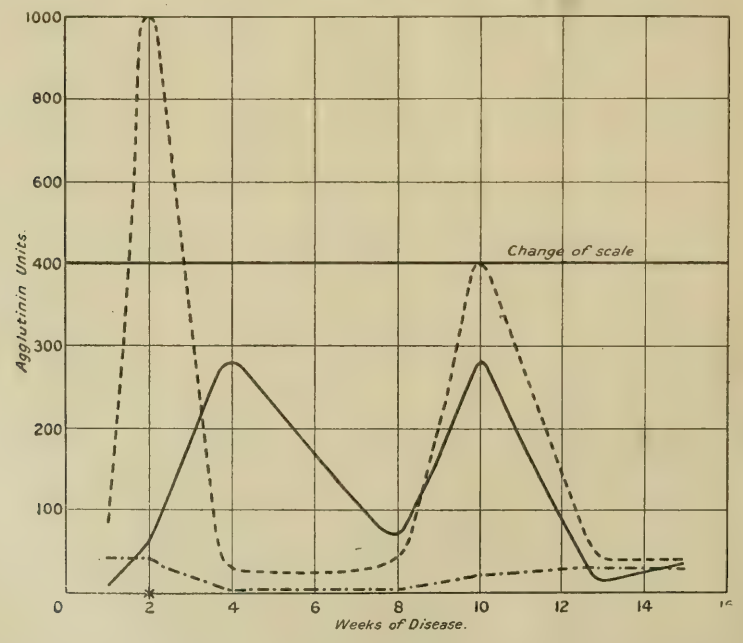

CHART B.—H. Price (see Table I, No. 2). Inoculated T.A.B. Para. A isolated from blood and fæces.

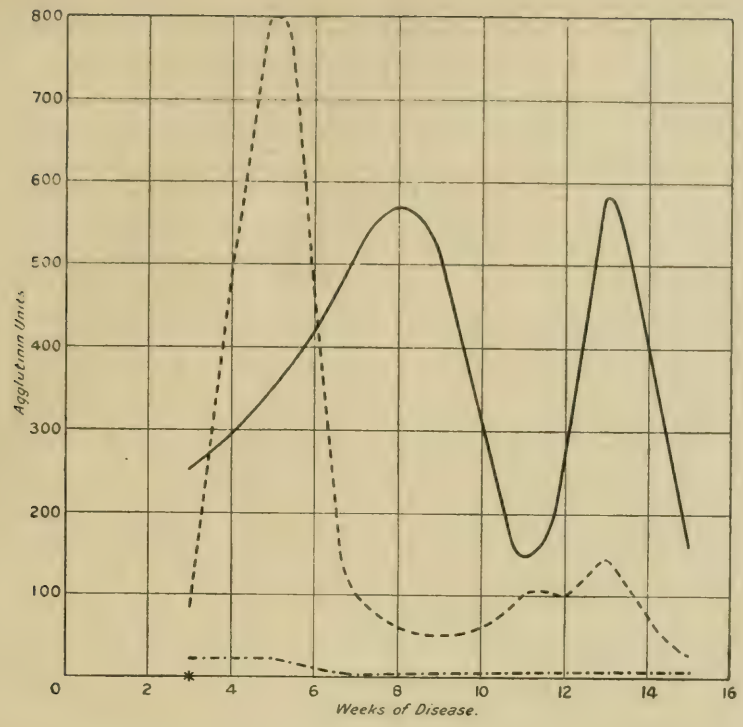

CHART C.—Blake (see Table I, No. 8). Inoculated T.A.B. Para. A isolated from fæces.

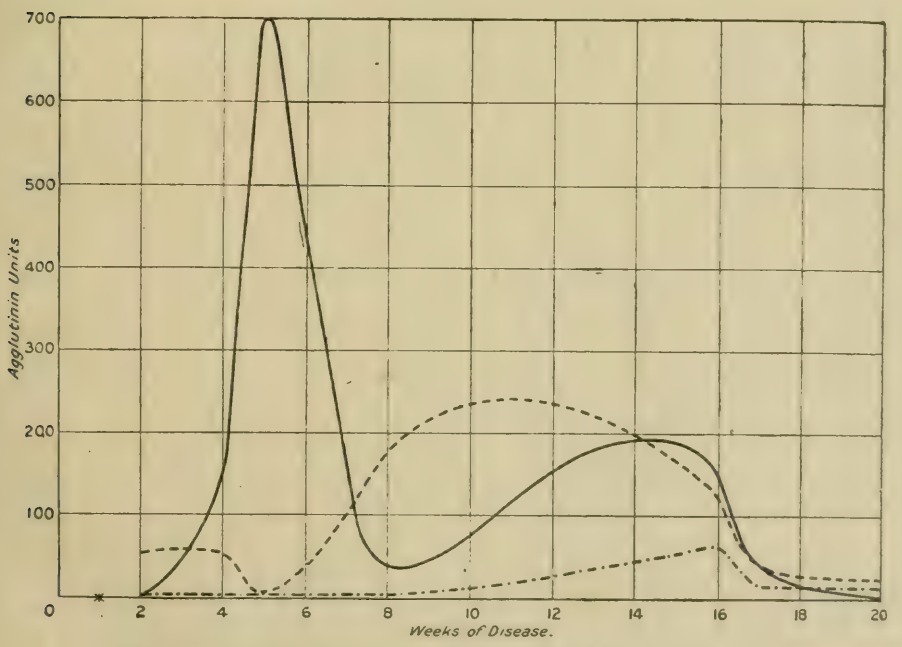

CHART D.—Weedan (see Table I, No. 10). Inoculated T.V. and T.A.B.

In Case 4, where the pyrexia lasted twenty-five days, agglutinins were absent on both examinations during the second and fourth week, the maximum production of para A agglutinins not occurring until the seventh week, while they were preceded by a rise in *B. typhosus* during the sixth week.

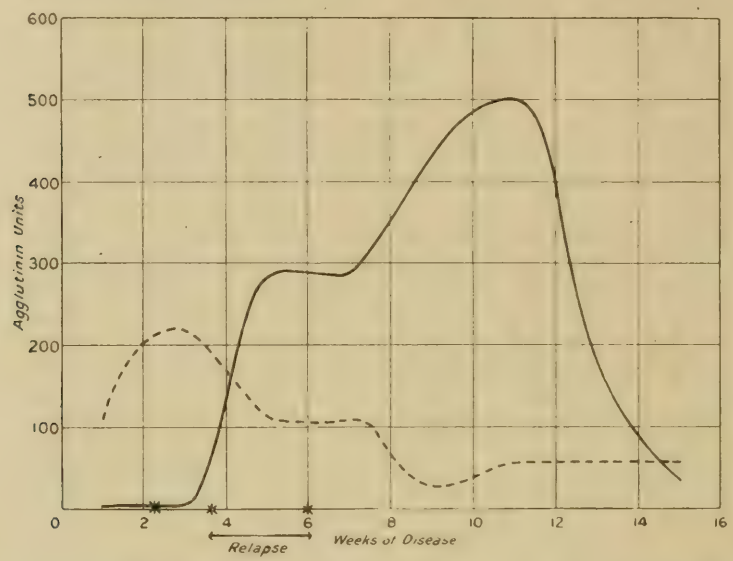

CHART E.—Coen (see Table I, No. 17). Inoculated T.A.B. Para. A isolated from fæces.

Case 8, another instance in which *B. paratyphosus* A was isolated from the fæces, has the agglutinin curves graphically represented in Chart C. The patient first came under investigation almost at the end of his three weeks' fever, when the figures for the para A agglutinins were 250, as compared with 80 for *B. typhosus*. This was just at the commencement of the rapid production of para A agglutinins which increased until during the seventh and ninth weeks their estimation was 510 units. Thereafter followed a rapid fall, while an unaccountable rise occurred during the thirteenth week which could not be associated with any obvious clinical feature of the case.

No. 9 is interesting in that the pyrexia was indefinite although the man's clinical history was suggestive of an "enterica" infection of an ambulatory type. Here again para A agglutinins were high during the fourth to the sixth weeks from the onset of the illness.

Case 10 (see Chart D) was admitted with a diagnosis of appendicitis towards the end of the second week of his illness. There was a history of one week's fever. The Widal reaction to para A was altogether negative even in low dilutions on the fourteenth day, but there followed a marked production of agglutinins during the fourth and fifth weeks. After a rapid fall there was a subsequent slight rise during the twelfth to the sixteenth weeks. This is another of those cases in which para B agglutinins make their appearance in late convalescence.

TABLE II.—Agglutination Titres of Cases inoculated with T.V. only.

No. of case	Name	Weeks since inoculation	Nature of inoculation	Duration of pyrexia	Organism isolated		Week of Disease (titre expressed in agglutinin units)																	
							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Wood ..	91	T.V.	4 weeks, followed by relapse, 32nd to 39th day	Para A (fæces)	T.	0	..	60	..	12	0	..	40	..	..	..	..	100	..	100	..	..	..	100	100
						A.	0	..	80	..	650	285	..	15	..	..	..	..	30	..	30	..	..	..	20	30
						B.	0	..	0	..	0	0	..	0	..	..	..	..	0	..	0	..	..	..	0	0
2	Miles ..	56	T.V.	19 days	Para A (fæces)	T.	..	100	..	..	..	10	..	225	..	100	..	50	..	50	..	..	..	..	..	..
						A.	..	0	..	..	..	185	..	30	..	140	..	140	..	50	..	..	..	..	..	..
						B.	..	0	..	..	..	0	..	0	..	0	..	0	..	0	..	..	..	..	..	..
3	Calver ..	52	T.V.	4 weeks	..	T.	..	225	..	80	40	40	10	20	..	40	..	..	..	..	..	..	..	..	..	..
						A.	..	35	..	1000	35	70	140	70	..	70	..	..	..	..	..	..	..	..	..	..
						B.	..	0	..	0	0	0	0	0	..	0	..	..	..	..	..	..	..	..	..	..
4	Gray ..	70	T.V.	26 days	..	T.	..	20	..	80	..	..	100	..	1000	..	..	50	..	200	..	..	..	..	..	..
						A.	..	0	..	0	..	..	140	..	325	..	..	280	..	140	..	..	..	..	..	..
						B.	..	0	..	0	..	..	0	..	0	..	..	0	..	0	..	..	..	..	..	..
5	Wilson ..	65	T.V.	2 weeks	..	T.	20	..	..	100	..	10	20	..	..	..	..	..	..	..	..	..	..	..	..	..
						A.	3	..	..	0	..	145	15	..	..	.	..	..	..	..	..	..	..	..	..	..
						B.	0	..	..	0	..	0	0	..	..	..	..	..	..	..	..	..	..	..	..	..
6	Royce ..	106	T.V.	4 weeks	..	T.	0	..	..	0	..	..	360	..	100	..	..	..	..	..	..	..	..	220	220	..
						A.	0	..	..	180	..	..	214	..	0	..	..	..	..	..	..	..	..	3	6	..
						B.	0	..	..	0	..	..	0	..	0	..	..	..	..	..	..	..	..	0	0	..
7	Clewlow ..	100	T.V.	No record obtainable	..	T.	..	..	..	..	..	..	..	25	..	100	..	20	..	..	..	20	..	5	..	..
						A.	..	..	..	..	..	..	..	100	..	120	..	60	..	..	..	15	..	15	..	..
						B.	..	..	..	..	..	..	..	0	..	0	..	0	..	..	..	0	..	0	..	..
8	Ormrod ..	50	T.V.	4 weeks	..	T.	..	..	12	..	12	..	50	..	..	25	..	..	..	..	..	..	..	..	..	..
						A.	..	..	25	..	35	..	190	..	..	5	..	..	..	..	..	..	..	..	..	..
						B.	..	..	0	..	0	..	0	..	..	0	..	..	..	..	..	..	..	..	..	..
9	Symonds ..	70	T.V.	2 weeks	Para A (fæces)	T.	10	..	..	..	20	..	10	..	..	..	..	..	..	..	..	..	..	..	..	..
						A.	30	..	..	..	70	..	30	..	..	..	..	..	..	..	..	..	..	..	..	..
						B.	0	..	..	..	0	..	0	..	..	..	..	..	..	..	..	..	..	..	..	..
10	Wilkins ..	100	T.V.	2 weeks	..	T.	..	0	..	..	..	..	..	..	22	..	..	..	..	..	..	..	..	..	..	..
						A.	..	0	..	..	..	..	..	..	285	..	..	..	..	..	..	..	..	..	..	..
						B.	..	0	..	..	..	..	..	..	0	..	..	..	..	..	..	..	..	..	..	..
11	Harvey ..	100	T.V.	1 week	Para A (fæces)	T.	..	12	..	..	..	..	..	..	50	..	..	..	..	..	..	150	..	..	..	..
						A.	..	30	..	..	..	..	..	..	70	..	..	..	..	..	..	30	..	..	..	..
						B.	..	0	..	..	..	..	..	..	0	..	..	..	..	..	..	0	..	..	..	..
12	Portass ..	74	T.V.	2 weeks	..	T.	..	14	440	..	28	..	57	..	14	..	..	..	..	..	..	..	..	..	..	..
						A.	..	7	142	..	71	..	568	..	142	..	..	..	..	..	..	..	..	..	..	..
						B.	..	0	0	..	0	..	0	..	0	..	..	..	..	..	..	..	..	..	..	..
13	Berry ..	70	T.V.	3 weeks	..	T.	..	22	..	44	..	28	..	44	..	..	..	..	..	..	..	..	..	..	..	..
						A.	..	142	..	280	..	142	..	280	..	..	..	..	..	..	..	..	..	..	..	..
						B.	..	0	..	0	..	0	..	0	..	..	..	..	..	..	..	..	..	..	..	..
14	Hendry ..	Not inoculated		10 days	..	T.	10	5	5	10	20	20	..	..	20	..	20	..	..	..	..	..	..	..	..	..
						A.	0	0	30	37	5	37	..	..	30	..	30	..	..	..	..	..	..	..	..	..
						B.	0	0	0	0	0	0	..	..	0	..	0	..	..	..	..	..	..	..	..	..

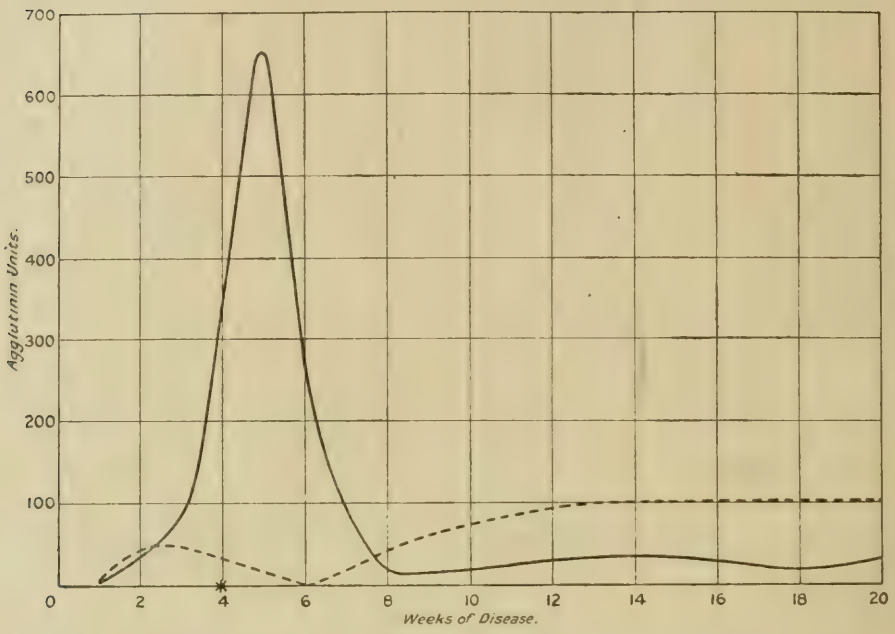

CHART F.—Wood (see Table II, No. 1). Inoculated T.V. Para. A isolated from fæces.

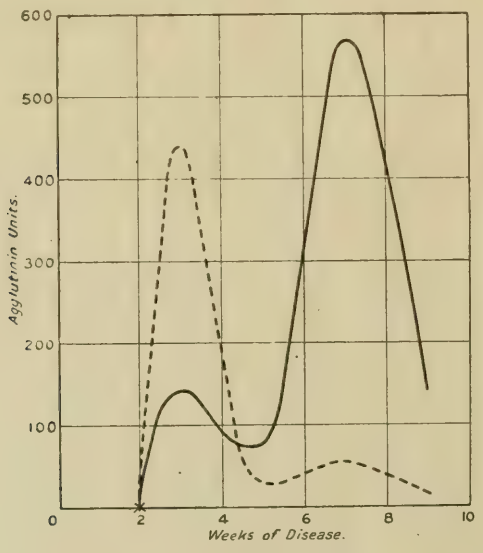

CHART G.—Portass (see Table II, No. 12). Inoculated T.V.

In Case 11, in which no agglutination examination was done until the sixth week when the continuously remittent fever was dying down, a marked production of para A agglutinins was recorded in the eighth week, while a high figure—420 units—was also obtained in the twelfth week. *B. paratyphosus* A was isolated from the fæces during convalescence.

No. 12 is interesting in that a relatively low figure for all agglutinins was obtained at the various examinations, although *B. paratyphosus* A was isolated on numerous occasions from the stools. Of course there is the possibility that the high figure may have been missed when it is recollected that the rise is often rapid and short-lived, and in this case the examinations were unfortunately made only at fortnightly intervals. This observation applies also to certain of the other cases where the agglutination reactions were carried out at irregular or infrequent intervals.

Case 13 shows the maximum production for *B. paratyphosus* A in the sixth week with a persistently high figure until late in convalescence, viz., sixteenth week. The para A bacillus was isolated from both the blood and fæces. No. 15 is noteworthy in being a case of jaundice, a sequela to *B. paratyphosus* B infection, the organism being isolated from the fæces in this laboratory. The patient's fever had lasted fourteen days, and he first came under our observation in the sixth week of illness, when the record for para B agglutinins was 571 units. Although para B agglutinins were on all five examinations distinctly more marked than the agglutinins for both *B. typhosus* and *B. paratyphosus* A, yet it is to be noted that para A agglutinins were distinctly present, a higher agglutination titre being recorded than that for *B. typhosus* in four out of the five agglutination tests.

In Case 17 we have clinically a sixteen days' typical enteric type of fever followed by a continuously intermittent temperature from the twenty-fourth to the forty-fifth day. Agglutination tests for *B. paratyphosus* A were completely negative during the first and third weeks (see Chart E). In the fifth week para A agglutinins were quite marked, and continued to increase up to the ninth and eleventh weeks, after which a rapid decline occurred. *B. paratyphosus* A was isolated during convalescence. It is to be noted that para B agglutinins were consistently absent during all the eight agglutination tests, although T.A.B. inoculation had taken place only six weeks previous to the onset of the fever.

The following are the most interesting cases of Table II, that is, of the patients inoculated with anti-typhoid vaccine only. Case 1 (see Chart F) is a long continued fever of four weeks' duration followed by a relapse from the thirty-second to the thirty-ninth day during which *B. paratyphosus* A was isolated from the fæces. Nine agglutination tests were altogether performed between the first and twentieth weeks, the result being altogether negative on the third day, while para A agglutinins reached their maximum production during the fifth and sixth weeks. No preliminary rise in *B. typhosus* agglutinins was detected here, although it may have occurred during the second week when no examination was made.

Case 2 is interesting in being an example of the type of case in which no para A agglutinins, even in low dilutions, were present on the fourteenth day, the figure for *B. typhosus* being 100 units. The case was clinically one of the "enterica" group, but no blood for another examination was obtained until the sixth week when para A agglutinins equalled 185 units, while they were persistent until the last examination made in the fourteenth week from the commencement of the fever. *B. paratyphosus* A was isolated from the fæces in the sixth week.

Case 4 is a similar case to the last, no para A agglutinins being present on the second and fourth weeks, the fever lasting twenty-six days. Lower dilutions than 1 in 25 were not put up in this case. In Case 6 the para A agglutinins almost entirely disappeared after being markedly present in the fourth and seventh weeks. No. 7 is one of those cases in which the patient was admitted to this hospital with a diagnosis of typhoid fever. (Report received: Widal positive to *B. typhosus* 1 in 250 in Mesopotamia). Our first examination made in the eighth week gave a figure of 100 units for para A agglutinins which were persistently present until the last examination on the eighteenth week. Moreover, it is to be remembered that the patient had had T.V. inoculation only. In Case 12 (see Chart G) with a typical fever of fourteen days the highest agglutination titre for para A was not recorded until the seventh week when a figure of 568 units was obtained.

Case 14 is one of the most interesting of the series. He had never been inoculated, and while in this hospital convalescing from benign tertian malaria he developed a ten days' fever of a typical enterica type with concomitant symptoms. The agglutination test on the third and tenth days respectively gave a figure of ten and five units for *B. typhosus*, while para A agglutinins even in low dilutions were altogether absent. On the twenty-first day, i.e., eleven days after the patient became febrile, the production of para A agglutinins amounted to thirty units, and they were still present when the last examination was made in the eleventh week from the commencement of the fever.

Discussion of the Results.

The cases recorded in the protocols have all had agglutination reactions carried out with sufficient frequency to justify deductions being drawn as to the type of the infecting organism, while they at the same time demonstrate the late response of the para A agglutinins. It has been possible in fourteen out of the thirty-three cases to isolate the organism, so that the agglutinin curves can be correlated with the bacteriological findings in over forty per cent of the records. Although the numbers are relatively small, yet this confirmation of the serological findings by the isolation of the organism affords data sufficient for drawing certain deductions in regard to the period and persistency of production of para A agglutinins.

(*To be continued.*)

Clinical and other Notes.

RECENT DEVELOPMENTS IN ROYAL ARMY MEDICAL CORPS FRONT LINE EDUCATION.

By Lieutenant-Colonel GUY N. STEPHEN.
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One of the interesting by-products of this War has been the development of a vast amount of educational force. Evidence of its existence could be adduced from various quarters, but to establish his statement the writer need do little more than point to the geographical area which throughout has been the scene of chief activity.

In France and Flanders new methods of defence have necessitated the invention of new methods of attack, and vice versa, while the aggregation of huge numbers of men in an unaccustomed environment has led to the principles of wound treatment and disease prevention being applied on a previously unexampled scale. In this work nearly every form of science and art has played its part, the net result being that no one who survives the War can well leave France with his mental outlook unwidened and unpossessed of at least elementary knowledge of some subject not previously within his ken.

Regarding it as a whole the education has been unconscious—the result of taking part in the application of new methods, of witnessing their operation, of camp fire discussing of passing events. But much of it has also been intentional, the authorities having seen in many instances the need of securing the right use of some new method or some new knowledge by the establishment of a definite school. In fact, a spot map of the British war zone in France prepared at any time during the last two years would have shown it to be freely peppered with schools devoted to the teaching of one war subject or another.

In such directions the Army Medical Service, it need scarcely be said, has shown itself no less active than other branches, and the degree of success it has attained is well worth attention.

As an example the work of an Army (R.A.M.C.) School of Instruction may best be taken since the school has been sufficiently long established, as war-time goes, to have attained a wide reputation.

It began its work in a real school—one of the many splendidly built French educational buildings that have figured so largely in the work of the R.A.M.C. in France—which was being used as a habitation for a casualty clearing station. At this time, the end of October, 1917, some of its wards had already been closed owing to the frequency with which the neighbourhood was shelled, and when shortly afterwards it was entirely closed owing to the same cause, the school was moved to another casualty clearing station, which owing to the inactivity of the military operations then in progress had plenty of room at its disposal.

General Principles.

The general aims of the school may be described as including the following :—

(1) To provide instruction in improved methods of doing the work required of the Royal Army Medical Corps in front line areas.

(2) To put workers in these areas into touch with any knowledge that has been gained at bases or elsewhere and with which it is to their interest to become conversant, either because it has a bearing on their own work or on general grounds.

(3) To fill in the gaps which exist in the military education of so large a proportion of existing medical officers, and to furnish them with a wider view of the general aims of military medicine than they are likely to gain by work in any single medical or military formation.

(4) To break down the mental barriers which subconsciously arise between men, who, although all parts of the same machine, have very different duties assigned to them.

The means employed to fulfil these various aims and the subjects taught in connexion with them naturally vary with the classes to which the pupils belong. Of these there are several—officers, non-commissioned officers and men belonging to the Royal Army Medical Corps itself, or to the sister services of the various Dominion contingents; officers and other ranks belonging to the medical corps of the American and Portuguese Forces, and officers and "other ranks" drawn from combatant units of all the before mentioned forces.

The length of instruction also varies, but less widely. For officers and "other ranks" belonging to medical formation each course lasts ten days, while four days complete the course for combatants. In both cases the students arrive early in the afternoon of the day preceding the opening of the course, so as to have time to settle down comfortably, and they start off back to their units on the afternoon of the final day. The date of this final day is coincident in both courses, since the four-day course for combatants begins on the seventh day of the medical course.

The Army medical officers and "other ranks" told off to attend these courses are drawn mainly from among regimental medical officers, and from field ambulances and sanitary sections and squads, with a smaller proportion of officers belonging to casualty clearing stations or in charge of labour groups. The pupils from the combatant units are usually platoon officers, stretcher-bearers, and members of regimental sanitary squads, together with a few men employed or in training as regimental chiropodists.

For men belonging to sanitary sections and squads, as also for chiropodists, specialized instruction is provided, but the hours devoted to it are so arranged as to enable the men to share in the general instruction when this is of a kind likely to be useful to them. Much the same might be said indeed of the work of all the different classes of student, since for all are provided both specialized as well as general lectures and demonstrations.

In dealing with the combatant classes, the chief aim perhaps is to make them practically conversant with the best ways of rendering first-aid, and to impress on them the value of sanitation and show them how it can best be secured even in front line conditions; while the special lectures for medical officers deal with the new developments in the medicine and surgery of war. The general work covers pretty nearly the whole field of first line work, and invariably deals with methods of obviating shock.

Fitting in all the lectures and demonstrations is often a task of great difficulty, more especially since it is regarded as an essential principle that mental surfeit—

which inevitably leads to lack of attention—shall be avoided. Consequently, even though the particular form of instruction may happen nominally to be a lecture, it is made to assume as far as possible the character of a demonstration and is invariably limited in point of time to well within an hour.

The authorities moreover do not aim at achieving results solely by lectures and demonstrations. A part at least of the object of the latter is to create such active interest in the subjects to which they relate that the students shall subsequently discuss among themselves and with the staff the various points raised, and thus act as instructors to one another. The general aim, in short, is to promote "shop talk" from the beginning to end of each day.

The Day's Work.

The formal day's work begins at 8.30 a.m. and ends in the afternoon about 4.30 p.m. As will be at once noted it is not a long day, especially as allowance of time for breakfast and luncheon is generous. Nevertheless it admits of the delivery as a rule of two or three lectures and of a corresponding number of practical classes or demonstrations, and leaves the students quite fresh-minded enough to discuss things amongst themselves and take part perhaps in an organized debate on some subject, which though not forming part of the school course has a common interest for all. It is easy to theorize about front line work, but if one wants to learn in how many different ways the same piece of work can be performed, and to determine which is really the best of them, then attendance at one of these debates is highly to be commended.

The education provided by these debates and by the "shop talk" in general is entirely informal, but for disciplinary and other purposes the rest of the work is accompanied by a certain amount of ceremonial.

Discipline.

The passage of the day is marked by bugle calls and before the first morning lecture there is a roll call and parade, the students marching off in fours to their work. The actual beginning of each day's morning work is half-an-hour at "physical jerks" before breakfast, and the actual beginning of each afternoon's work is another parade and about half-an-hour's squad and company drill. The Commandant presides at all general lectures, and the lecturers or demonstrators do not enter the room until all the students are assembled. The latter stand at attention as the lecturer proceeds up the room, and when the lecture is over do not leave their places until formally dismissed. Otherwise than in respect of these details the whole course is conducted on informal lines, though in the mess hut the usual practices of well-run messes on active service are observed and a notice of them is posted in the ante-room.

An additional point worth noting is that in the case of all officers each course ends with as close a reproduction as possible of the pomp and circumstance of a regimental guest night in time of peace. The proceedings include, of course, the formal toasting of His Majesty the King; a band lent by some near-by division plays throughout dinner in the ante-room, and when the formal proceedings are at an end the guest-night gambols commence and continue till the Mess President gives the word for departure. The aim of this evening is not merely festive. No doubt it forms a very pleasant feature of the course, but the object of the authori-

ties is to promote a general feeling of *esprit de corps* and to give young officers some idea of the mixture of ceremony and of good fellowship which characterizes garrison and cantonment life in times of peace. The final proceeding of all—just before the luncheon bugle blows on the day of separation—is a short address by the D.M.S., followed by a formal inspection and a march past.

Administrative Details.

Having thus set forth the general principles underlying the work of the school, it remains to supply a few details as to the administrative side of the enterprise and the choice of subjects for instruction.

Accommodation.

The school considers itself full when its "medical" students number 40 officers and 60 "other ranks," and its "combatant" students 10 and 130 respectively.

The requisite number for each course is secured by the D.M.S., who at the beginning of each course distributes the accommodation for the following course among the various units of the command. As the courses are very popular, it is only through accidental circumstances that vacancies are ever left unfilled.

Rations and fuel are drawn for all in attendance and officer students contribute to the mess fund a fee of 7.50 francs, and pay 2.50 francs per diem in addition. The fund thus formed has hitherto amply sufficed not only for the upkeep of the mess, but also for the provision of the various appliances required for demonstration purposes. The linen and crockery used in the officers' mess hut were lent by the British Red Cross Society.

The school buildings are formed by empty huts belonging to the casualty clearing station in which the school does its work. The principal lecture room is a French-pattern hut measuring ninety feet by thirty feet. The principal demonstration hut was formerly a recreation room. There is also a hut used by the officers as sleeping quarters, one for non-commissioned officers and two others for men. All ranks bring their ordinary camp kits, the officers placing these on bedsteads belonging to the casualty clearing station, while trestles and stretchers with palliasses are provided for non-commissioned officers, and stretchers, with palliasse mattresses beneath, for the men.

One cook-house serves all three messes and also such part of the casualty clearing station as is still used. The latter has been mainly utilized during the past winter for local sick and for cases of bomb injury among the civilian population in the neighbourhood.

The school office is the orderly room of the casualty clearing station. The arrangements for demonstrations were built by the Sanitary Section in whose area the school lies. The horses used are drawn from various field ambulances in the command, and are changed at the beginning of each course. For demonstrations in approved methods of field cookery, the students attend a cookery school a few miles distant.

Personnel.

From the foregoing details it will be seen that in the matter of housing, equipment and upkeep, the school costs nothing, since everything that it uses is either lent to it by some other formation or is provided by moneys resulting from its own existence.

An equivalent statement may be made in regard to the establishment of the school, since everybody who takes part in its tutorial or other work is either on temporary loan from another unit or is voluntarily performing school work in addition to other duties.

Subject to this consideration, the teaching staff may be said to consist of a commandant, an instructor, an adjutant, a quartermaster, 3 warrant officers, 5 serjeants, and a number of visiting lecturers. In addition there are 2 cooks, 1 corporal, 1 bugler and about 33 privates.

The commandant is also commanding officer of the casualty clearing station in which the school does its work. The adjutant is on loan from a field ambulance, and the instructor is a surgical specialist lent by one of the less active casualty clearing stations not far away.

Of the warrant officers, two are loaned from field ambulances to which they return for the four days which elapse between the courses. Both have had pre-war experience as instructors in physical exercises and bandaging respectively. The third warrant officer belongs to the A.S.C. attached to a field ambulance; he takes charge of the horse-lines and also acts as assistant riding-master.

Of the five serjeants one is in charge of the lecture rooms and is responsible for everything required at lectures and demonstrations. The other four are men who have distinguished themselves by their aptitude at a first course, and are retained at a second course to act as pupil teachers. All five are on loan from R.A.M.C. formations.

The corporal, the two cooks and the bugler are part of the ordinary establishment of the casualty clearing station. Of the privates about 12 are A.S.C. drivers lent by field ambulances and sent with the horses simultaneously loaned, in the proportion of 1 groom to every 2 horses. Of the rest, 4 act as assistants to the serjeant in charge of the lecture rooms, 2 as guards in the horse-lines, and the rest as mess servants and batmen. All these belong to the category of "B" men, that is to say they are men fit for ordinary fatigue work but not for duty with fighting troops. One batman is found to be sufficient for every six officers, and it is a rule of the school that they should not be "tipped."

As for the visiting lecturers, some take part in the work of every course, and others help only at one course or deliver merely a single lecture. Of the former the principal are the D.M.S. of the Army, its consulting physician and consulting surgeon, an officer in charge of one of the mobile laboratories, and the officer in sanitary charge of the area in which the school is situated.

The other visiting lecturers are drawn from any source in or out of the Army that is available. Men distinguished in some particular line and likely to be interesting are invited.

Subjects Taught.

The tuition afforded by the school is identical at each course only within certain limits; that is to say the field of work is always the same, but it has not hitherto been found practicable to give every yard of it the same amount of attention at each course. This is partly because the school has to depend a good deal on chance assistance, partly because, except in regard to a few subjects, it has not yet been decided exactly what knowledge should and can be secured in every pupil in the limited time at disposal.

The difficulties that exist in this connexion may perhaps best be suggested by giving a list of some of the titles of lectures and demonstrations that have been given since the school first opened its doors last November. The subjects invariably taught can be considered subsequently. Roughly classified, the list is as follows:—

Professional.

The Obscure Diseases of War.
The Treatment of Wound Shock.
The Surgery of War Wounds.
The Pathology of Gas Gangrene.
The Variety and Recognition of Shell and Drift Gas Cases.
The Meaning and Importance of Pyrexia of Unknown Origin.
The Early Treatment of Gunshot Wounds of Chest.
War Neuroses.
Wound Infections and their Complications.
The Objects of Medical Research.
Medical Clerking and Records.
Indents and how to prepare them.
The Duties of Regimental Medical Officers.
Relation of Royal Army Medical Corps Officers to other Officers.

Horse Mastership.

Horses, Sick and Well.
Saddle-fitting.
Horse Mastership.
Stables, Horses and Saddlery.

Law.

Military Law.
What is Evidence?
Offence Reports.

Lectures for Other Ranks.

The Duties of Other Ranks in Camp.
Duties on the Line of March.
The Duties of N.C.O.s
Relations of N.C.O.s to Officers and other Ranks.

Organization.

The Prevention of Disease.
The Prevention of Medical Diseases in War.
Organization of the Medical Services.
Organization of the Lines of Communication.
The Rôle of the Rest Camp.
The Return of Convalescents to Duty.
The Prevention of Sick Wastage.
The Working of Casualty Clearing Stations.
Motor Transport.
Billets and how to get them.

Miscellaneous.

Marching and the Care of Feet.
The Prevention of Trench Foot.
The Hygiene of Foodstuffs.
The Carriage of Casualties from the Fighting Line
Stretcher Carrying in Duck-board areas.
Stretcher Carrying in and out of Trenches.

The Field Pannier and its Contents.
Water-carts and their Upkeep.
Vapour Baths and their Use.
The Meaning of Conservancy.
Methods of Rechauffement.
The Prevention of Shock.
The Customs of the Service.
The Chaplains Department and its Relations.
Map Reading.

Many of these lectures and demonstrations, though differently entitled at different courses, really cover much the same ground; and judging from the time-tables of a number of courses, the authorities would generally seem to aim at securing in each course 3 or 4 lectures on surgical and medical subjects, half-a-dozen on questions of administration and organization, 2 on horse-mastership, and 1 or 2 on military law.

The subjects invariably taught are the application of the Thomas splint with special reference to the prevention of shock; the application of the rifle splint; the arrest of hæmorrhage; the use of the triangular bandage; and the construction and use of field sanitary appliances. In addition, all ranks take part in physical exercises and ordinary drill, and all medical officers are given riding lessons, and attend demonstrations of useful ways of varying the use of the food-stuffs issued as rations.

These subjects are mainly dealt with by practical classes. For none of these is it claimed that any particular method taught is necessarily the best that might be conceived; merely that it is a good one. When large bodies of workers are in question a good method with which all are familiar is better than an "improved" method known only to a few.

In regard to the Thomas splint course, the surgical view instigating this teaching is the one now universally accepted in France. Immobilization of parts before evacuation from an advanced dressing station, or even a regimental aid-post, should be secured in all cases of fracture of the femur, in extensive flesh wounds of the thigh, in injuries to the knee-joint, and in severe fractures in the upper part of the tibia; and the Thomas splint is the best to use, except when a fracture of the femur is complicated by an unusually extensive wound in the buttock or upper part of the thigh of such a kind as to interfere with the fitting of the ring. The method of application taught secures attention to the value of warmth and of absence of pain in the prevention of shock, and does not involve the removal of either clothes or boots or exposure of the wound until complete immobilization is achieved. It also assumes that the operator will have not more than two assistants, possibly only one.

The principle on which it is taught is that in applying the Thomas splint in the circumstances of an advanced dressing station or regimental aid-post no thought should be necessary but every movement automatic. To secure this result the whole process has been worked out in the form of a definite drill in which the various groups of movement are indicated by numbers. Presumably it will be described in detail separately in the Journal, so it suffices here to say that it covers everything from the initial warming of the patient by blankets and a primus stove (this being movement No. 1), to fixing the splint to a suspension

bar on the stretcher, and the placing in position for the journey of hot bottles and blankets (these being movements Nos. 11 and 12).

As to the value of this drill it seems to be sufficiently indicated by two facts: a man who knows it well can carry it out with entire efficiency in the dark; and in the competition with which the teaching of this subject always ends, teams of "other ranks" often beat teams of officers in perfection of detail and speed of completion. The former do exactly what they have been told to do and the latter use their "judgment" which may or may not be good. A first-class team can put up a limb perfectly in two minutes forty-five seconds, and an average team in about four minutes.

The teaching of the use of the rifle splint and the triangular bandage is of an equally practical kind and all classes of student take part in it. The arrest of hæmorrhage is taught by the D.M.S., who uses a mechanical appliance consisting of a set of tubes with forceps hung on a naked man to demonstrate the course of the principal vessels, the difference between arterial and venous bleeding, and how and where arteries can be controlled by finger pressure.

All classes receive instruction in sanitation, the number of sessions and the character of the teaching varying with their assumed initial knowledge. The appliances used for teaching purposes are models of those which have best stood the test of long experience. For the most part they have been evolved during the present campaign. They include methods of protecting food from contamination; disposing of excreta in different circumstances; and the destruction of parasites in clothing and equipment.

The drill and physical exercises absorb about one and a half hours each day. Besides securing due exercise in all ranks, they smarten up everybody all round. During the last three years many field ambulances have been paraded to receive the thanks of a Divisional or Army Commander for work done by them, and on such an occasion a proper sense of *esprit de corps* demands that nothing in the turn-out or movements of the men shall remind the visiting officer that ordinary drill enters little into their lives. At the drills the medical officer students are encouraged but not obliged to take command of sections or the whole parade. This is very useful because some of them have had no previous experience and many are rusty. A medical officer in charge of a party of stretcher-bearers or other group of men ought not to be dependent on his serjeant when he wishes to halt them, alter their direction, or move them out of the way of a passing lorry or a gun when marching along a road.

The riding classes take place every afternoon, every medical officer receiving four or five lessons. The work includes mounting and dismounting at word of command; maintaining pace and position, and negotiating a few small fences. All medical officers are supposed to be able to ride, but many of the pupils are entirely beginners; the fact that many of the horses used are a bit rough does not make the work any less useful.

Concluding Observations.

Opinion in France as to the value of the school is perhaps best represented by saying that at the time of writing several other armies are taking steps to duplicate it in their own areas. Should the War continue for another winter there is no doubt they will succeed, but in view of the apparent imminence of a

German offensive this is at present impossible. They can secure a sufficiency neither of pupils nor teachers except when military operations are so inactive as to allow men of both classes to be diverted from their ordinary operations.

Nevertheless, even should the Army (R.A.M.C.) School of Instruction shortly close its doors and never be duplicated, its existence will have been thoroughly justified: about 400 officers and 1,500 N.C.O.s and men have passed through the curriculum, and it has been shown how much can be done without either an elaborate establishment or an expensive equipment. It has provided many dozens of men with knowledge entirely new to them, and in others has crystallized knowledge which previously was vague; in all it has stimulated attention to a subject of the highest importance in front line work, namely, the preventive treatment of shock.

In conclusion, it may be said that a school of this order depends for its success little on its situation and not very much on the character of its visiting lecturers, but to an infinite extent on that of the resident staff. They must be men quite free from the schoolmaster spirit, but who are thoroughly conversant with their subjects, and capable of expounding them readily.

In particular, the commandant should be a man of wide sympathies, a gregarious person, a man whose knowledge of front line work is so complete that he can understand the point of view of all the different classes of pupils; a man naturally disposed to take his many small troubles cheerily, and to whom the various ropes of Army life are so familiar that he knows exactly which at any given moment he can leave slack and which tighten in order to maintain exactly the right admixture of discipline and ease. For one factor in a school of this order is that a course thereat should be regarded as a privilege and a pleasant break in front line life.

TWO VIBRIO SPECIES OF THE "PARACHOLERA" GROUP ASSOCIATED WITH A CHOLERA-LIKE OUTBREAK.

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AND
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It must be recognized that, besides the typical epidemic cholera of Asia, due to a vibrio with the biological characters of the classical *Vibrio choleræ* (Koch), cholera-like conditions may be produced by other vibrio species. As suggested by Castellani,[1] a choleraic disease causally associated with a vibrio which cannot be identified with the *V. choleræ*, might be designated paracholera. Of course, the cholera vibrio is capable of undergoing variations in its characters, and such variants are to be carefully distinguished from entirely different species. Thus the El Tor vibrio of Gotschlich (1905),[2] which differed from the classical type in

[1] *Brit. Med. Journ.*, March, 1916, No. 2,882, p. 448.

[2] "Scientific Reports, Sanitary, Maritime, and Quarantine Council of Egypt, Alex.." (1905, 1906).

producing a powerful hæmolysin, nevertheless reacted to a specific anti-cholera serum, and in virtue of its serological correspondence to the classical *V. choleræ*, has been regarded as a variety of the cholera species. It has also been asserted by various observers that strains of *V. choleræ* under certain conditions may lose their specific serological characters, e.g., agglutinability by an anti-cholera serum, so as to simulate non-cholera species; but it is generally accepted that the failure of a vibrio to correspond to the *V. choleræ* in this serological character is evidence that it belongs to an entirely different group.

The object of this communication is to describe the vibrio strains which were isolated from certain choleraic cases occurring in the form of a small localized outbreak in one of the convalescent hospitals in Egypt. In many of their characters these strains bore a distinct resemblance to the classical *V. choleræ*, but were easily differentiated by their serum reactions, and we have, therefore, classified them as paracholera vibrios.

Clinical Summary of the Cases.

On October 26 Pte. G., a patient convalescing from "pleurodynia," developed a sudden acute illness which presented the characteristic clinical signs and symptoms of asiatic cholera. The condition started with severe colic, followed by intense diarrhœa and vomiting, and severe cramping pains in the thighs and legs. The intestinal evacuations were typically "rice-water" in character. The acute stage was followed by a state of extreme collapse with subnormal temperature, low blood-pressure, sunken eyes, cold livid skin, and a weak, husky voice. He was treated in the collapsed state by intravenous injection of hypertonic saline solution, and subsequently made an uninterrupted recovery. It is of interest to note that this patient had been suffering from digestive disorder for six days previous to the onset of the choleraic illness.

The same day, October 26, another patient, Pte. B., in the same hospital, suddenly developed acute diarrhœa with abdominal pain and cramps in the legs, but the illness was not so severe as in the first case, and was not associated with any degree of collapse, though the blood-pressure was relatively low. This man had been suffering for some months past from recurrent diarrhœal attacks.

On the following day, October 27, three other patients in the hospital, Pte. C., Trpr. W., and Pte. P., developed acute choleraic diarrhœa. In the case of Pte. C., the condition was associated with abdominal pain and vomiting, but without marked collapse. The intestinal discharges were of the "rice-water" type. Unlike the other cases, the diarrhœa persisted after the acute phase. On October 31 typical dysenteric (blood and mucus) stools were passed, and the temperature rose to 100° F. *B. dysenteriæ* (Flexner-Y type) was isolated; anti-dysenteric serum was administered with rapid subsequent recovery. This man had been invalided from Mesopotamia with "anæmia," and, previous to the acute illness, had a slight diarrhœal attack in the convalescent hospital.

Trpr. W.'s illness did not amount to more than an acute but transient diarrhœa, with little general disturbance. This patient had an "enteric" illness in August. The day before the acute attack he had slight diarrhœa.

Pte. P. suffered from a more acute diarrhœa, with vomiting, cramps in the legs, and some degree of collapse. He had "dysentery" in May, and several attacks of diarrhœa since that date.

On October 28, at midnight, an R.A.M.C. orderly, Pte. L., who had been in attendance on Pte. B. the same day, suddenly developed an acute choleraic condition, which was more or less similar to that of Pte. G., and was associated with marked collapse. His evacuations during the acute stage were typically "rice-water" in character. He, however, made a good recovery after two days' illness.

From all the cases vibrios were isolated. In the cases of G., L. and P. large numbers of vibric-like organisms were quite evident on microscopic examination of the discharges.

On November 1 another patient in the hospital developed an acute cholera-like illness. The diarrhœal stage, which lasted about eleven hours, was followed by a collapsed state with complete cessation of the diarrhœa. The first stool passed after this, about twenty-four hours after the onset of the illness, was examined, but no vibrios were detected. Specimens of the earlier evacuations were not obtained for bacteriological examination.

In the case of G., vibrios were detected on the first and second days, but were found to be absent on the third day from the onset of the illness.

In the other cases also the vibrios disappeared rapidly from the fæces.

The presence of vibrios in large numbers during the acute phase and their rapid disappearance after recovery was considered to be indicative of their causal relationship to the disease. From the clinical standpoint certain of these cases, particularly that of Pte. G., were quite characteristic of Asiatic cholera. Others were of a distinctly milder type.

Appropriate preventive measures were at once taken when vibrios were found in the first case; and after November 1 no further choleraic cases were reported.[1]

Isolation of the Vibrios.

Tubes of peptone water were inoculated from the intestinal discharges, and incubated at 37° C. for six to eight hours. On examination, they were found to represent an almost pure culture of actively motile vibrios. A loopful of the thin pellicle growth on the surface of the medium was introduced into fresh peptone water tubes, which were incubated for a period of about twelve hours. A practically pure culture was thus obtained by enrichment, and the strains were isolated from colonies on Dieudonné plates inoculated from the first or second peptone tubes.

The six strains corresponded in their morphological and cultural characters.

Morphological Characters. — Actively motile, comma-shaped organisms, measuring generally 1·3 to 2 microns in length and 0·4 micron in breadth. There was, however, considerable variation in size, and "S" forms were noted in young cultures. Films from older cultures showed the characteristic involution forms of the cholera vibrio. In preparations stained for flagella according to the method of Nicolle and Morax[2], a single terminal flagellum, about three times the long diameter of the vibrio, was observed.

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[1] A systematic examination of all the patients in the hospital revealed a number of healthy vibrio carriers. The carrier question in connexion with the outbreak is still under consideration, and will be dealt with in a later communication.

[2] Besson: "Practical Bacteriology, Microbiology, and Serum Therapy." Translated by H. J. Hutchens, p. 151.

Staining Reactions.—The vibrio was Gram-negative in young cultures. It stained well with the ordinary stains. In older cultures the staining reaction was faint.

Cultural Characters.—All the strains grew well on the ordinary media under aerobic conditions, both at 37° C. and at 22° C.

Stroke cultures on sloped agar, after twenty-four hours at 37° C., consisted of a moist whitish growth somewhat more abundant and more opaque than that of a *V. choleræ*. After two or three days it tended to assume a slightly brownish-yellow colour.

Colonies on agar, after twenty-four hours at 37° C., were moist white, somewhat raised, with a completely circular well-defined margin, and more opaque than those of the *V. choleræ*. The average diameter of twenty-four hours' colonies was two to three millimetres. After forty-eight hours they began to assume a yellowish-brown colour.

In gelatine stab cultures (15 per cent. gelatine) at 16° C. to 18° C., a white line of growth was apparent in twenty-four hours. In thirty-six to forty-eight hours' liquefaction had begun at the upper end of the stab, and by the third or fourth day a distinct cup had formed with a funnel of liquefaction extending down along the line of inoculation. Liquefaction proceeded more rapidly than in the case of the cholera vibrio, though otherwise the type of growth was similar.

In peptone water the vibrio grew rapidly, producing a thin pellicle on the surface, and at the same time a general turpidity of the medium. There was no apparent pigment production.

On MacConkey's and Dieudonné's Media.—Grew well, producing colonies which were somewhat larger than those of the *V. choleræ*. The colonies on MacConkey's medium, after forty-eight hours, showed a characteristic yellowish-brown colour, and were less raised and opaque than the colonies on ordinary agar.

On Alkaline Potato Medium.—An abundant moist white growth developed at 37° C. after twenty-four hours. In four or five days it assumed a characteristic pinkish-brown colour.

On solidified blood serum at 37° C. abundant growth and rapid liquefaction occurred, so that in thirty-six hours about three-quarters of the sloped medium was completely liquefied. A typical *V. choleræ* in the same time liquefied about one-quarter of the same amount of serum medium.

Bio-chemical Reactions.

The results of the fermentative tests were as follows:—

Glucose	.. ..	Acid; no gas	
Galactose	.. ..	,, ,,	
Lævulose	.. ..	,, ,,	
Maltose	.. ..	,, ,,	
Saccharose	..	,, ,,	
Mannite	.. ..	,, ,,	
Dextrine	.. ..	,, ,,	
Glycerine	.. ..	,, ,,	
Dulcite	..	No acid-production after ten days	
Adonite	..	,, ,, ,, ,,	
Rhamnose	..	,, ,, ,, ,,	
Raffinose	..	,, ,, ,, ,,	
Inulin	..	,, ,, ,, ,,	
Salicin	..	,, ,, ,, ,,	
Sorbite	..	First day slightly acid; later alkaline	
Milk	..	Slightly acid; no clot; later digested	
Lactose	..	At first no active production. After seven to ten days distinctly acid except in the case of Strain W.	

Cholera red reaction (depending on the formation of nitrites and indol) was markedly positive after eighteen hours' growth.

Hæmolysis, tested by growing on blood agar, was slow, but quite evident after thirty-six hours.

Phosphorescence was absent.

Serological Reactions.

Anti-cholera Serum.

Agglutination.—There was no agglutination of any of the strains by a 1 in 50 dilution of an anti-cholera serum (Lister Institute), whose highest titre was 1 in 2,000. The agglutination test was repeated after the strains had been subcultured several times with a similar negative result. Similarly, strains isolated from the experimental animals (*vide infra*) also reacted negatively.

Complement deviation.—There was no deviation of complement by any of the strains in combination with the anti-cholera serum, though a marked complement deviation reaction was elicited in the case of a typical *V. choleræ*.

Patients' Sera.

Agglutination.—The sera of the six cases were tested seven days from the onset of the illness, both with the strain isolated and also with a *V. choleræ*. Pte. G.'s serum was found to agglutinate his own strain, and the *V. choleræ* in dilutions up to 1 in 200 after four hours.

None of the other sera reacted to the strain isolated or to *V. choleræ*. G. had been inoculated twice in January, 1916, with cholera vaccine. The serum of a healthy person, inoculated three months previously with cholera vaccine, did not agglutinate the same strain of *V. choleræ* in dilutions higher than 1 in 20, and did not act on strain G. even in a 1 in 20 dilution.

The development of specific agglutinins is strongly suggestive of the causal relationship of the vibrio to the disease with which it was associated. Of course this was the only case that reacted in this way, but it must be remembered that the agglutination reaction even in true cholera is somewhat variable, and, though often well developed in non-fatal cases, is frequently quite absent, as the protocols of Greig's[1] investigations show.

The phenomenon is therefore not a constant one, even in true cholera infections. As regards the concomitant reaction of G.'s serum to *V. choleræ*, it might be supposed that a re-exaltation of the post-inoculation agglutinins had resulted in an analogous fashion to that which occurs in the case of paratyphoid patients previously inoculated with typhoid vaccine (Mackie and Wiltshire).[2]

G.'s serum was re-tested a month from the onset of the illness. It was found that the end titre of the agglutinins for both strain G. and *V. choleræ* was now 1 in 100.

Agglutinating Anti-serum to Strains G. and L.

Rabbits were immunized by intravenous injection of successively increasing doses of cultures sterilized at 65° C. An anti-serum was in this way first obtained for strain G. and its agglutinating properties towards the other strains and also a typical *V. choleræ* were observed. The results are shown in the following table :—

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[1] *Indian Journ. of Med. Research*, January, 1915, vol. ii, No. 3, p. 733.

[2] Unpublished observations on the diagnostic interpretation of the agglutination test in typhoid and paratyphoid infections occurring among typhoid vaccinated troops.

Agglutinating Serum v. *Strain G.*

	Strain :	Dilution of serum 1 in 100	1 in 200	1 in 400	1 in 800	1 in 1,600	1 in 3,200	No serum
G. ..	..	++++	++++	++++	+++	+	—	—
W. ..	.	++++	++++	++++	++++	+++	—	—
P. ..	..	++++	++++	++++	++++	++	—	—
C. ..	..	++++	++++	++++	++++	++	—	—
L. ..	..	—	—	—	—	—	—	—
B. ..	..	—	—	—	—	—	—	—
V. cholerœ ..		—	—	—	—	—	—	—

Readings made after four hours.

++++ represents complete agglutination, and the various degrees of partial agglutination by +++, ++ and +.

When it was found that strains L. and B. were not agglutinated by the anti-serum to G., an immune serum to strain L. was obtained and tested with the different strains and with *V. cholerœ*. The results were as follow :—

Agglutinating Serum v. *Strain L.*

	Strain :	Dilution of serum 1 in 100	1 in 200	1 in 400	1 in 800	1 in 1,600	1 in 3,200	No serum
G. ..	..	—	—	—	—	—	—	—
W. ..	..	—	—	—	—	—	—	—
P. ..	..	—	—	—	—	—	—	—
C. ..	..	—	—	—	—	—	—	—
L. ..	..	++++	++++	++++	++++	++	+	—
B. ..	..	++++	++++	++++	++++	+++	++	—
V. cholerœ	..	—	—	—	—	—	—	—

Readings made after four hours.

++++ represents complete agglutination, and the various degrees of partial agglutination by +++, ++ and +.

These results clearly show that the six strains can be classified into two different species. Thus the immune serum to G. agglutinates G., W., C., and P., but has no action on L. and B., while conversely the immune serum to L. agglutinates L. and B., but has no effect on the representatives of the other species. Both types are also shown to be specifically different from *V. cholerœ*. In this connexion it is of interest to note that L. was probably infected by contact with B. (*vide* Clinical Summary).[1]

Pathogenic Effects on Animals.

Guinea-pigs : All the strains were tested by intraperitoneal injection of one-half of a twenty-four hours' agar-slope culture. Animals show signs of collapse after two or three hours, and died in four to six hours.

Post-mortem.—The abdomen was markedly distended, and the peritoneum contained great excess of fluid, which was turbid and in some cases blood-stained. Small intestine.—The mucosa and whole intestinal wall was inflamed: it contained no normal fæcal material, but was full of an opaque yellowish mucous fluid, slightly blood-stained ; microscopic examination revealed large numbers of

[1] The strains isolated from the "carriers" (*vide supra*) have not yet been completely classified; some are agglutinated by the anti-serum to G., and some by the anti-serum to L.: others do not react to either. (These strains are still under investigation and will be dealt with in a later communication).

vibrios and abundant cellular exudate. Vibrios were recovered by culture from the heart blood, the intestinal mucus and the peritoneal exudate. These effects correspond to the action of certain cholera vibrio strains.

Pigeons: Two of the strains were tested by injection into the pectoral muscle of a one-fortieth of a twenty-four hours' agar slope culture. No pathogenic effect was produced.

Rabbits: The results in the case of the rabbit experiments were very striking and it was possible to reproduce a typical cholera picture post-mortem by intravenous injection of as small a dose as one-eightieth of a twenty-four hours agar-slope culture. The six strains for the different cases were all tested with similar results. In general, after injection of one-twentieth of a culture into the ear vein the animals died in about twenty-four hours or less. In one case, strain G., there was a marked diarrhœal condition before death.

Post-mortem: The small intestine contained no normal fæcal material; the mucosa was inflamed and the lumen distended with a white milky mucous fluid, or in some cases a blood-stained muco-purulent material. The intestinal fluid contained an abundant cellular exudate with masses of exfoliated epithelium. The inflammatory condition was usually most marked in the lower part of the small intestine. Cultures of the intestinal fluid on MacConkey's medium in some cases consisted of a pure growth of vibrios.

These animal experiments show a highly selective toxic action on the mucosa of the small intestine, and correspond to the pathogenic effects of the classical *V. choleræ*.

It will be seen from the bacteriological description that these vibrio strains closely resemble in many of their characters the *V. choleræ*, but that they are differentiated chiefly by their serological reactions. As regards the general cultural characters any difference which exists is quantitative rather than qualitative; thus the liquefaction of gelatine and solidified serum is more marked and the growth on the various media more abundant. The bio-chemical characters are in general similar. The hæmolytic test distinguishes these strains from the classical cholera vibrio, but, on the other hand, varieties of the cholera vibrio which respond to certain of the specific reactions have been shown to be hæmolytic,[1] e.g., Ruffer's Groups II and III, which are probably variants of the classical vibrio type. Group II was characterized by a positive agglutination and Pfeiffer's reaction, but complement fixation was absent. Group III shows absence of Pfeiffer's reaction, though the agglutination and complement fixation tests were positive.

It has been disputed by various observers whether agglutinability of a cholera vibrio by an anti-cholera serum is a fixed and constant character. Thus it was shown by Crendiropoulo[2] how inagglutinability might occur in the human body: he found that agglutinable vibrios in the fæces were succeeded after a time by inagglutinable vibrios in the bile. Greig[3] has shown how an inagglutinable water vibrio after isolation from the bile of an experimental animal tended to alter its

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[1] Ruffer, 1907, *Brit. Med. Journ.*, 1, p. 735, and Ruffer, Calmette, Gaffky, Geddings, Murillo, Praun and Potterin, 1911, "Le Diagnostic bactériologique du choléra," Paris.

[2] Crendiropoulo: "Recherches sur les vibrios au Lazaret de Tor." Alexandria. 1913.

[3] *Indian Journ. of Med. Research*, vol. iii, No. 3, January, 1916, p. 442.

morphological and serological characters, so that it approached more closely to the standard *Vibrio choleræ*. Chalmers and Waterfield[1] in a recent paper discussed fully the biological classification of the various types of vibrios, and concluded that the evidence was in favour of the agglutination test as a suitable means of differentiating the cholera group from other vibrios. The fact that anti-sera to strains G. and L., while strongly agglutinating homologous strains, fail to affect a typical *V. choleræ* which reacts to the anti-cholera serum is conclusive proof that these vibrios strains are specifically different from the cholera group.

As regards the identification of non-cholera vibrios, Chalmers and Waterfield have recently elaborated a system of classification in which they recognize the following groups: (1) Albensis; (2) Cholera; (3) Metschnikovi; (4) Gindha; (5) Finkler and Prior; (6) Drannani; (7) Terrigenus.

According to this classification our strains appear to correspond to vibrios of the Gindha group, defined as follows: "Vibrios, motile, aerobic, non-phosphorescent, growing in and liquefying gelatine, not producing pigment in peptone, not agglutinated by true cholera immune serum in 1 in 200 or greater dilutions, with growths in gelatine stabs resembling those of *V. choleræ*, and not causing death in twenty-four hours in pigeons when injected into the pectoral muscles in small quantities."

Chalmers and Waterfield described a vibrio strain of this type which they showed was causally associated with a case of paracholera occurring at Port Sudan in December, 1915, and identified it with the *V. Gindha* (Pfeiffer) which was found in the water of a well at Gindha (in Erythrea) where there had been an epidemic of cholera some months previously. In the same communication the various vibrio types which they recognized as belonging to the Gindha group were further classified. These included among other species the *V. Gindha* and the *V. Kegallensis*. The latter was described by Castellani as a paracholera vibrio, and was found by him to be associated with a cholera-like disease in Ceylon. Non-cholera vibrios have also been described from time to time in choleraic and diarrhœal cases by different observers, and Greig has described non-cholera strains in cases of "cholera," but as he failed to obtain any agglutination reaction by the patients' serum to these strains, and they were also noted in association with typical cholera vibrios, he had apparently disregarded them as causative organisms. It would be important that in future all such strains should be carefully identified and classified. With reference to the choleragenic properties of these paracholera vibrios it is of significant interest that a human experiment with the original *V. Gindha* resulted in a severe cholera-like illness.[2]

The *V. Gindha* was differentiated from the other members of the group according to Chalmers by (1) the power of reducing nitrates and forming indol—on which the cholera-red reaction depends; (2) the rapid liquefaction of blood serum. In the case of the *V. Kegallensis* the cholera-red reaction was absent.

According to these criteria our strains would correspond to the *V. Gindha*,

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[1] Chalmers and Waterfield, *Journ. of Trop. Med. and Hyg.*, No. 14, vol. xix, July 16, p. 165.

[2] Macé: "Traité pratique de Bactériologie." Sixth Edition. II, pp. 591-656. Paris. Quoted by Chalmers and Waterfield.

but they nevertheless present a striking difference from this type. Thus on alkaline potato medium they produce a characteristic pinkish growth, while that of the *V. Gindha* as described is of a maize-yellow colour. The cholera-red reaction differentiates our strains from the *V. Kegallensis*.

It appears doubtful if this system of classification is sufficiently complete for the identification of the paracholera vibrios. It is probable that this group comprises a number of different types or species, and that these may be classed and identified not only by their cultural characters but also by their specific serum reactions. Thus, of the six strains isolated by us from these choleraic cases, we have been able to show that four are specifically different from the other two, though all present similar cultural characters.

The evidence is strongly in favour of these strains being causally related to the cholera-like disease with which they were associated, and we have therefore classified them as paracholera vibrios. For future reference the two species represented respectively by strains G. and L., might be designated *V. paracholeræ* A and B (Mackie and Storer, 1916).

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MILITARY CATEGORIES IN DISEASES OF THE EAR.

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For the purposes of classification, a useful working system for defects of vision and ocular affections has been in existence for many years, but, so far as I have been able to ascertain, no uniform or practical scheme has been adopted for defects of hearing or diseases of the ear.

In attempting to supply this want I would venture to put forward the plan on which I have worked during the past two years.

The rough visual test of reading large type at a certain distance is easily carried out by the medical examiner at the recruiting centre or elsewhere in the case of men who have good vision, but when more or less gross errors of refraction and other defects are present, the valuation of these becomes the duty of the ophthalmic surgeon. Similarly, a man who in the compass of a large-sized room, say, twenty feet across, appears to readily hear without hesitation the various questions which it is essential to ask him and which are addressed to him in a quiet, even, conversational voice and in the absence of the history of any past or present suppuration, may be presumed to have normal hearing. But when such questions have to be repeated to him or the speaker's voice has to be raised, or a history of deafness with or without suppuration is given or ascertained, the case should then pass on to the aural surgeon for examination. It is with the latter type of case that I propose to deal.

I place them in two main groups as follows :—

(A) Deafness (without active suppuration).

(B) Suppuration (active with deafness).

Group A includes the following :—

(1) Middle-ear deafness: (*a*) Middle-ear catarrh; (*b*) otosclerosis; (*c*) past suppurations, but membranes well healed and no recurrences for many years.

(2) Internal ear deafness, which includes a family type.

(3) Mixed middle and internal ear deafness: (*a*) Advanced middle-ear catarrhal cases; (*b*) artillerymen, who have been exposed to long periods of intense gun-fire; (*c*) some shell concussion cases, middle and internal ear lesions combined (*b* and *c* may also come under heading 2).

Owing to the vast complexity of our present military organization, a man with deterioration of hearing up to thirty or thirty-three per cent can be placed in low categories and may be usefully employed in labour teams with others who have good hearing, but those with grosser losses than this should be excluded from the Service.

Grades of Deafness.—Cases of deafness I place in four grades according to approximate loss of hearing, as 15 per cent, 20 per cent, 25 per cent, and 30 per cent to 33 per cent, which are graphically represented as follows: D1, D2, D3 and D4.

Grades of Suppuration.—Cases of suppuration are also placed in four grades and are graphically represented as follows: S1, S2, S3, S4.

S1.—In this grade there is some membrane loss, large or small, but the drainage is good. (Good drainage is the first and last essential in the treatment of suppuration.) The middle-ear cavity is dry or only slightly moist with mucus or pus. Occasional recurrences of suppuration may arise, usually with head colds, and are due to Eustachian tube infection from the throat, naso-pharynx or nose. The middle-ear cavity can be seen as a definite space beyond the free edges of the partially destroyed membrane, and is usually lined with epithelium and free from ulceration or naked granulations (vascular elevations not covered with epithelium). The deeper the middle-ear cavity, the better the ventilation and drainage facilities.

S2.—The membrane loss may be large or small, but the drainage is bad for one of the following reasons: (*a*) The membrane may show a small perforation situated a considerable distance above the floor of the middle-ear cavity; (*b*) the middle ear cavity is anatomically shallow and not a clear, deep, roomy space, free of the damaged edges of the membrane; (*c*) the membrane may be very little destroyed, but is adherent to the promontory and inner wall of the tympanum; (*d*) large granulation areas or polypi may obstruct the exit of pus from the tympanic cavity; (*e*) marked narrowing of the meatus due to chronic eczema and inflammatory pus infections of the meatal tissues is present.

S3.—Membrane loss, large or small, with bad drainage and in addition some inflammatory infiltration outside the limits of the middle-ear cavity, such as the meatal walls. When such disease exists posteriorly and superiorly, along the margin of the tympanum, the question of radical mastoid operation will arise, as well as the risk of the disease extending to the lateral sinus and cranial cavity, with any fresh exacerbation of the middle-ear infection. Cranial complications are, however, comparatively rare.

S4.—Cases similar to S2 and S3, but with definite symptoms and signs of labyrinthine irritation, with or without labyrinthine fistula.

This classification of cases according to anatomical features, facilities of drainage, site of lesion and extent of disease, is of considerable practical help in enabling

one to arrive at a fairly definite prognosis and to decide upon the best line of treatment.

Voice Tests for Hearing.—The common method of standing at measured distances from the patient and asking him to repeat certain words and phrases, whispered or spoken by the examiner, I never employ, because the man becomes conscious at once of being tested and if so disposed he will exaggerate or malinger. My routine plan is to sit at a table with a large note-book before me into which particulars of the cases are entered and the patient is seated about three feet away on my left, within easy reach for examination of his ears. He is freely interrogated in a quiet, even, conversational voice on all particulars pertaining to himself, such as rank, number, age, service, his duties now and those of his civil life and notes are made of the answers. The voice is not directed towards him, but at right angles to this line, and writing is continued, so that in this way he is not conscious of being tested. The voice is at times lowered and the effect noted. If in this way he appears to hear distinctly and without hesitation and needs no repetition of questions, he is not more than 20 per cent deaf. If he requires occasional repetition—say, one in four—he is 25 per cent deaf. A definitely Rinné negative patient who has full absolute bone conduction will require the occasional repetition of some questions. An exception to this rule will be found at times in certain cases of active suppuration where it is often noticed that they hear better when freely suppurating than when the disease is arrested. If questions have to be frequently repeated or the voice raised the hearing is 30 per cent or more deteriorated. If he gives a history of having been turned off drills and parades permanently for not responding to orders owing to deafness, his hearing is 30 per cent or more deteriorated.

Tuning-fork Tests.—The tests which I employ most and consider of greatest value in estimating degrees of deafness are Rinné's and absolute bone conduction. The C2 is the fork chiefly used and that of Lucae with a striker attached to the stem is the one which I employ. It can be heard by bone conduction (meatus open) for fifteen seconds, and by air conduction for twenty-five seconds. In the absolute bone conduction test the end of the fork stem is applied to the patient's mastoid over the antrum (his meatus being closed by finger pressure on his tragus) until he ceases to hear it, and it is then transferred to the examiner's mastoid, whose meatus is also closed and any difference in the periods for which it is heard is noted.

If bone conduction is full, Rinné's test is of considerable value in estimating middle-ear deafness, and about 8 per cent of the cases one meets with are of this type.

When Rinné's test is definitely negative and bone conduction full, I place the loss of hearing at 25 per cent approximately. The definite Rinné with full bone conduction is therefore taken as a standard of loss, and variations in air and bone conduction are estimated by comparison with this.

Summary of Tests.

Fork used, Lucæ C2 { B.C. (Bone conduction) = 15 seconds.
A.C. (Air conduction) = 25 ,,

D1, both ears { B.C. full.
A.C. shortened a little but longer than B.C. = Rinné plus = 10 to 15 per cent loss approximately.
Conv. voice : answers freely without hesitation.

D2, both ears { B.C. full. A.C. and B.C. equal. Rinné = plus minus = 15 to 20 per cent loss approximately. Conv. voice : heard without hesitation.

D3, both ears { B.C. full. A.C. definitely shorter than B.C. = Rinné minus = about 25 per cent loss

(This is taken as the standard of depreciation for fixing percentages.)

Conv. voice : heard well, but occasional need for repetition of some questions.

D4, both ears { B.C. definitely shortened. A.C. also shortened = Rinné plus, or plus minus, or minus = about 30 per cent loss.

(Internal ear or mixed middle and internal ear deafness.)

Conv. voice : frequent repetition of questions and finally voice has to be raised, so much so that a person with normal hearing will hear it distinctly about 30 feet away.

How Categories are arrived at, New Classification (A, B, D, E).

One ear is normal, hearing equals 100 per cent.
Other ear is in grades D1, D2, D3, D4, 15, 20, 25 and 30 per cent loss.
When combined average loss of two ears is 10 per cent or under = Category A.
Combined loss (average) is about 10 to 20 per cent = B1. (Abroad, any theatre of war.)
,, average loss is about 25 per cent = B2 or B3. (Abroad.)
Average loss is about 30 per cent = B2 or B3 (Home Service.)
Above 33 per cent = E.
Suppuration, S1, = hearing D1 and 2, = B1. (North-West Europe.)
,, S1, = ,, D3 ,, 4, = B2 and 3. (North-West Europe.)
,, S2, = ,, D1 ,, 2, = B2. Hearing, D3 and 4 = Biii. (North West Europe.)
,, S3, = ,, D1 ,, 2, = B2. ,, D3 ,, 4 = B3 (Home Service.)
,, S4, = E.
Cases of S2 and S3 when the disease is active may be temporarily placed in Category D.

FIVE CASES OF METASTATIC GAS GANGRENE—THREE FOLLOWED BY RECOVERY.

By Captain J. V. J. HARTLEY.
Royal Army Medical Corps.

That micro-organisms, in cases of gas gangrene, gain entrance to the blood-stream and produce lesions in distant parts of the body, is perhaps of more frequent occurrence than is generally supposed. This in the majority of cases is a terminal phenomenon and readily escapes notice. Colonel Wallace [1] in his contribution on gas gangrene mentions two cases in which metastatic lesions were manifest shortly before death and two similar cases are recorded by Kenneth Taylor [2]. Mullally and McNee [3] describe a remarkable case in which the bacillus of malignant œdema, circulating in the blood, became localized at the sites of injections of A.T.S. and pituitrin. During the past five months, five cases of metastatic gas gangrene have occurred in — General Hospital and three of these are of special interest, inasmuch as each made a satisfactory recovery.

The records of the five cases are as follows :—

Case 1 (under the care of Captain W. F. Neil, R.A.M.C., T.C.).—Cpl. A. was admitted on September 9, suffering from gunshot wounds of right upper arm. The humerus was comminuted and the wound very foul and septic. December 6 : Operation. Drainage improved and fragments of bone removed. December 9 : The

arm below the wound became cold and areas of discoloration and bullæ appeared on the forearm and hand. The patient was pallid, complained of thirst and vomited. The pulse was soft and running. Operation: The arm was amputated at the shoulder joint, the flaps being left unsutured. The same evening, crepitation was noticed in the left buttock. The extremities were cold and the pulse barely perceptible. One hundred cubic centimetres of eusol were injected into the median basilic vein. Shortly afterwards the pulse improved and he began to perspire profusely. December 10: The improvement was very transitory. Thereafter he rapidly grew worse and died at 2 p.m. An autopsy was made, soon after death, and the gluteal muscles of the left buttock were found to be greyish, soft and crepitant. A bacteriological examination demonstrated the presence of *Bacillus aerogenes capsulatus* in large numbers.

Case 2 (under the care of Capt. W. F. Neil, R.A.M.C., T.C.).—Cpl. B. was admitted September 17 with a gunshot wound of the abdomen. An operation had been performed at the casualty clearing station, and the ascending colon had been found injured. On his arrival at the base he had a fæcal fistula. Further examination revealed swelling and crepitation over the right deltoid. There were also the usual toxic symptoms associated with gas gangrene—a soft, rapid pulse, intense thirst and marked pallor. The same day an incision was made over the right deltoid, and the whole of the muscle was greyish-brown in colour, crepitant and spongy. A free excision was made and seventy cubic centimetres of eusol given intravenously. The patient rapidly grew worse and died the next day.

Case 3.—Pte. L., aged 22, was admitted September 5 with gunshot wound of the right arm. The missile had traversed the upper arm a short distance above the elbow and comminuted the humerus. The entrance and exit wounds were large and the brachial artery lay exposed. The forearm and hand were cold and presented a bluish mottling and numerous bullæ. Crepitation was detected, and bubbles of gas and a sanious fluid could be pressed from below into the wounds. The patient was pallid, had a dry foul tongue, and vomited. Operation: The arm was amputated a little above the insertion of the deltoid, a flap being taken from the outer aspect. September 6: Patient extremely ill. Pulse 140, respiration 32, temperature 103° F. Stimulants freely administered and 100 cubic centimetres of eusol injected into the left median basilic vein. September 9: General condition slightly better although there was extreme pallor and an insatiable thirst. Pulse 110, temperature 101° to 103° F., respiration 30. The flap had become necrotic, otherwise the stump was satisfactory. Pain was complained of in the right buttock, and on examination there was found to be some swelling and a suspicion of deep crepitation. September 10: The crepitation very distinct and extending over sacral and right iliac regions and down the back of thigh to within a hand's breath of the knee. The right buttock definitely tympanitic, and over the most prominent part there was a small area of bluish discoloration. Operation: Under a general anæsthetic, an incision was made to the right of the sacrum. Gas was present in the subcutaneous tissue, and gas and sanious fluid could be expressed from the right buttock. September 16: At the site of the bluish discoloration a small circular slough of skin formed. To-day the slough was gently removed, and along with it was extracted a greyish necrotic mass of muscle measuring four inches by two inches. The patient was decidedly better. There was no longer thirst, and he was now able to enjoy his food. The temperature

was falling by lysis. Pulse 26, respiration 24. September 20: The arm stump and wounds of buttock were now covered with healthy granulations, the patient rapidly gaining colour and strength, and this day was transferred to England.

Case 4.—Pte. W., aged 21, was admitted December 23, suffering from trench feet. The toes were bluish-black and cold. There were bluish patches and bullæ on dorsal and lateral aspect of feet and œdema of legs extending as high as the knees. The blisters were snipped, the feet washed with methylated spirits and boric powder and dry gauze applied. December 6: The feet became sodden and foul smelling. The bluish patches became confluent and an indefinite line of demarcation formed at the level of the ankle joints. There was pallor and thirst and the temperature rose to 103° F. and the pulse to 120. Operation—The left leg was amputated midway between ankle and knee; the right leg was amputated a hand's breadth above the ankle and as there was a suspicion of gas in the intermuscular planes, the lateral incisions were extended upwards and the short flaps left unsutured. The patient's general condition was so critical that the operation had to be hurriedly completed. Before he left the table a mixture of 100 cubic centimetres of eusol and 200 cubic centimetres normal saline was injected into the median basilic vein. December 7: Œdema of legs subsiding and stumps satisfactory, patient however extremely ill, mildly delirious and passing urine involuntarily; there was a bluish pallor of the face. Respiration 46, pulse 140. No dyspnœa and nothing abnormal to be found in the chest. One pint of saline and one cubic centimetre of pituitrin given subcutaneously. December 8: Still delirious. Respiration 48, pulse 120, temperature 101° F. December 9: No longer delirious but very weak and pallid; complained of pain in buttocks; on examination a small serous blister was discovered on the left buttock. December 12: Slight improvement; stumps satisfactory. The sclerotics had developed a marked icteric tint. December 13: Still complaining of pain in buttocks and this evening another examination made; both gluteal eminences tympanitic. The skin over sacral and lumbar regions œdematous and over the posterior superior spine there was an area of bluish-red discoloration; this state of affairs was remarkable, as the patient's general condition was decidedly better. There was still the waxy pallor, but the patient was feeling better and the tongue was clean and moist.

Operation.—Under a general anæsthetic, incisions were made downwards and outwards from the posterior superior spine; the subcutaneous tissue was slightly œdematous. On incising the deep fascia bubbles of gas and a thin yellowish blood-stained fluid escaped; the finger was inserted and greyish crepitant masses of necrotic muscle extracted; the wounds were lightly packed with dry gauze. December 16: Buttock wounds douched daily with hydrogen peroxide and eusol gauze applied; small greyish tags of muscle slough were separating and exposing early granulating tissue. Portions of the flaps of the right stump had necrosed, otherwise the stumps satisfactory; patient feeling stronger, enjoying his food and sleeping well. January 2: Temperature now been normal for a week. Buttock wounds and stumps clean. For several days patient had been allowed up on a chair and this day was transferred to England.

Bacteriological Examination.—A fragment of slough was examined by Captain W. E. M. Armstrong, R.A.M.C., and was found to contain *B. aerogenes capsulatus* in large numbers.

Case 5 (under the care of Captain G. Whittington, R.A.M.C.).—Cpl. P.,

was wounded in the right buttock, right arm and right shoulder by shell fragments on December 10. On December 12 the buttock wound was enlarged at the casualty clearing station and a small piece of shell removed from the bone close to the right acetabulum. December 14: Patient admitted to the base hospital. He was not markedly pallid but complained of thirst. Pulse 92, temperature 99·5° F. The wound in right buttock was about three inches in length and lay a little above and behind the great trochanter. There was a moderate amount of sepsis, which, however, was localized to the immediate neighbourhood of the wound. Accidentally it was found that deep crepitation could be made out in the opposite buttock. There was no discoloration of the skin. Operation: An incision was made downwards and outwards from the left posterior superior spine of the ilium and gas and a thin blood stained fluid escaped. A portion of the gluteus maximus, measuring two inches by three inches was greyish and crepitant and was excised. The wound was lightly packed with dry gauze. December 18: There was still a small amount of thin purulent discharge from the left buttock. The discharge contained fragments of muscle slough and had a characteristic and anaerobic smell. General condition much improved. January 3: For more than a week there was irregular pyrexia and this was in part due to the septic state of the wounds of the left arm. Now all the wounds were clean and granulating and his general condition was such as to allow of his being transferred to England.

Bacteriological Examination.—Captain W. E. M. Armstrong, R.A.M.C., reported on the gluteal discharge, that *B. aerogenes capsulatus* was present in large numbers and that in aerobic culture a coliform bacillus had been isolated.

It will be observed that in all of the three cases in which a bacteriological examination was made, the causal organism of the metastatic infection was the *B. aerogenes capsulatus*. Four of the secondary lesions occurred in the buttocks and it would seem—as Kenneth Taylor pointed out in his two cases—that continuous pressure due to the patient's posture was an important factor in the localizing of the metastatic infection. Whether the intravenous injection of eusol in Cases 3 and 4 was contributory to their recovery, it is impossible to say. In Case 5 there was recovery without the injection of eusol, but the remarkable feature of this case was, that despite the evidence of a systemic infection with the *B. aerogenes capsulatus*, there was an absence of marked toxæmic symptoms.

It will be noted that in the fatal cases 1 and 2 the intravenous injection of eusol was given, when the secondary lesions were already manifest and the patient obviously moribund.

In the successful cases 3 and 4 the intravenous injection of eusol was given early. The metastases occurred late and recovery followed with the minimum of surgical intervention. In Case 3 the extensive gas gangrene in the right buttock and thigh occurred five days after amputation of the right arm. Only a small incision was made for the secondary lesion, yet the infection became localized and a muscle slough separated of its own accord. In Case 4 the metastatic infection in both buttocks developed a week after the amputation of the gangrenous feet. Here, again, the operation for the secondary lesion was limited and no attempt was made to extirpate the infected muscles. One can only suggest that

in these two cases the intravenous injection of eusol delayed metastasis, and that prior to the secondary lesions the patient had time to acquire an immunity sufficiently powerful to overcome the disease.

I wish to express my thanks to Captain Max Page, R.A.M.C., for his help and advice, and also to Lieutenant-Colonel S. G. Butler, D.S.O., R.A.M.C., for his kind permission to publish the above cases.

REFERENCES.

[1] *British Medical Journal*, September 16, 1916.
[2] *Lancet*, December 23, 1916.
[3] JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, December, 1916.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

AUGUST, 1918.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
July 5, 1918.

With reference to the awards conferred as announced in the *London Gazette*, dated February 4, 1918, the following are the statements of service for which the decorations were conferred :—

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

Major (Temp. Lieut.-Col.) Arthur Carr Osburn, D.S.O., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. On seeing the enemy approaching close to his dressing station he carried out the evacuation of the wounded under heavy shell and rifle fire in the coolest and most gallant manner. Having cleared away all cases by ambulance train and cars he re-established his dressing station farther in the rear. As officer commanding bearer divisions, he constantly inspected his line of bearer posts and forward dressing stations under heavy fire. The successful evacuation of the wounded from the divisional front was due to his careful organization and fearless supervision under the most trying conditions. His was an example of gallantry, courage, and resource worthy of the highest praise.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. Ferguson Fitton Carr-Harris, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Hearing that ten men of another battalion were lying wounded in front of the position, he volunteered on completion of the relief to go to their rescue. He was out for eight hours of the night, found nine of the men alive, took two of them back to headquarters, and organized the rescue of the remainder. He showed great coolness and self-sacrifice.

Major (Temp. Lieut.-Col.) Charles Algernon Stidston, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when his dressing station was very heavily shelled throughout the whole day and received several direct hits. It was impossible to remove the wounded, and throughout the day he moved about continuously arranging for their safety with utter disregard of danger. It was owing to his fearless example and splendid organization that all the wounded were finally removed without further casualties.

AWARDED THE BAR TO THE MILITARY CROSS.

Capt. Cuthbert Delaval Shafto Agassiz, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of a bearer post. He remained working throughout an intense bombardment, in which some of his bearers were killed and wounded while loading ambulance cars. He was compelled to remove to dug-outs, and there persisted in his work until shelled out. Though driven back three times by machine-gun fire and gas shell barrages, he succeeded in reaching the aid posts with his bearers, and removed all the wounded.

Temp. Capt. Arthur Joseph Blake, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He did splendid work in collecting and evacuating the wounded, working throughout in the open regardless of the heavy hostile fire. Later, he did excellent work tending the wounded of several units, going out after dusk to bring in wounded men from the front of our line. During the withdrawal he took out a party and carried back seven stretcher cases for a distance of three miles, thereby preventing these men falling into enemy hands. He has at all times carried out his duties with fearlessness and courage.

Capt. Eric Alfred Charles Fazan, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During very heavy fighting his aid post twice passed into the hands of the enemy. Although all communication with him by day was cut off for two days, he remained with his wounded, 235 of whom passed through his hands. It was due to his determination that every wounded man and all the personnel of his aid post were safely removed.

Capt. Samuel McCausland, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of bearers evacuating the wounded at a village under heavy shell and machine-gun fire. When almost the whole village was in the hands of the enemy he continued to supervise the collection of wounded, and it was mainly due to him and his bearers that they were all so speedily removed. In an attack he performed splendid work by clearing wounded of his brigade under most difficult conditions.

Temp. Capt. James Wallace Macfarlane, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. During a heavy bombardment of a battery position he assisted another officer and a sergeant in putting out the flames in a gun pit which had caught fire. By his prompt assistance the gun was saved from serious damage and the ammunition from destruction.

Capt. Joseph Stephen Wallace, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Whilst in charge of an advanced dressing station and bearer squads, he frequently visited the regimental aid posts in the line and skilfully arranged his bearer squads to the best advantage. He also personally conducted ambulance cars to very advanced positions, thus being able to get a very large number of cases removed to safety in a short time. His coolness and courage during the whole period were a splendid example to his men.

AWARDED THE MILITARY CROSS.

Capt. Robert Vacy Clifford Ash, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When the enemy attacked and almost surrounded his dressing station he remained at his post under intense machine-gun and shell fire, attending the wounded with complete disregard of danger. He got all the wounded safely away, and was instrumental in saving the transport and a large part of the personnel of the field ambulance. He then volunteered to return at once to the firing line, where he did excellent work in a most exposed position. He set a magnificent example of courage and devotion to duty.

Capt. Arthur Joseph Beveridge, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. His dressing station was heavily shelled during an engagement, but owing to his determination, courage and initiative, a large number of wounded were attended to and evacuated from the danger zone.

Capt. John Holliday Blackburn, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When eighty stretcher cases as well as a number of walking cases were handed over by another division, and owing to heavy shelling it was impossible to move them during the day, he took forward an ambulance as close to the position as possible and organized the evacuation of the wounded. He showed splendid determination and resource.

Temp. Capt. Joseph Victor Cope, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of stretcher-bearers in an exposed position, which was subjected to intense fire. Though he was suffering from gas he remained at his post for two days, setting such a magnificent example to his men that the evacuation of the wounded went on throughout the bombardment. By his courage and devotion to duty he saved many lives.

Temp. Capt. David McMurray Dickson, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in tending the wounded under heavy shell and machine-gun fire. He was continually out during the day searching the battlefield for wounded. He showed courage of a high order on this and many other occasions.

Lieut. S. Dutt, Indian Medical Service.

For conspicuous gallantry and devotion to duty. He worked indefatigably and attended a large number of wounded belonging to various units at the aid post, which was under heavy shell and machine-gun fire, and rifle fire. His absolute coolness and steady devotion to duty were a splendid example to all.

Capt. (Temp. Major) John Douglas Fiddes, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in continuing to dress the wounded under heavy shell fire at the advanced dressing station. Although the dressing station received direct hits, he continued to work and saved many lives by his courage and untiring energy.

Capt. John Henry Pearson Fraser, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in organizing a new line of evacuation when the original line was blocked by the initial success of the enemy counter-attack. Many wounded had collected, but he got away over 100 stretcher cases, working unceasingly in the open thirty-six hours.

Capt. Philip Jacob Gaffikin, M.B., Royal Army Medical Corps (Special Reserve).
For conspicuous gallantry and devotion to duty while in charge of stretcher-bearers during an engagement. He directed the removal of the wounded under heavy shell fire, and showed great courage and resource.

Temp. Capt. Hugh Bernard German, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When his dressing station was heavily shelled he organized the removal of thirty-eight stretcher cases. He also rescued several wounded of another division under heavy shell fire. He established dressing stations without delay at various stages in an advance of four or five miles, and so enabled the wounded to be rapidly evacuated.

Temp. Capt. Frank Arthur Grange, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked night and day without any rest, attending wounded from all units under continuous shell fire. He also went up to the front line under heavy fire to attend to a severely wounded man, and succeeded in getting him away.

Temp. Capt. Edwin Allan Thomas Green, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked with ceaseless energy, attending and evacuating the wounded. He moved his aid post forward, and worked under heavy shell fire till the enemy were within a few yards of his aid post. He evacuated all save a few bad cases who could not be moved. His courage and presence of mind saved a large number of wounded falling into enemy hands.

Temp.-Lieut. Arthur Collis Hallowes, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of bearers. He succeeded in rapidly evacuating all the wounded under very difficult conditions. He attended to a severely wounded officer under machine-gun fire.

Temp. Capt. James Philips Jones, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked in the line for a fortnight organizing advanced dressing stations and bearer systems. During an enemy attack he was cut off from battalion headquarters, but established an aid post and worked under heavy fire in the open for thirty-six hours, attending to a large number of wounded. He showed the greatest courage and endurance throughout.

Temp. Capt. Frederick Bennett Julian, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He remained at his post attending to the wounded during an engagement with great courage and determination, though suffering severely from the effects of gas.

Temp. Capt. Arthur Griffith Hairland-Jones, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. During the operations he repeatedly reconnoitered the roads under heavy shell fire. By his example and leading he established communication with the most forward dressing stations, and succeeded in bringing up his ambulances and rapidly evacuating the wounded from very exposed positions.

Lieut. (Temp. Capt.) William Wyllie MacNaught, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He organized a bearer party during an action, and collected and cleared many wounded under heavy shell fire. His prompt and gallant action saved many lives.

Temp. Capt. James Manuel, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. During an enemy attack he showed the greatest courage in attending to wounded men who were lying in shell holes exposed to enfilade machine-gun fire. With complete disregard of his own safety he went from one shell hole to to another attending to the wounded, and continued at this work after he had been wounded himself.

Lieut. John Marshall, M.B., Royal Army Medical Corps (Special Reserve.)
For conspicuous gallantry and devotion to duty. When in charge of stretcher squads, he succeeded in evacuating all the wounded during a critical period of a withdrawal from a village, frequently going forward beyond the firing line in order to accomplish his task.

Temp. Capt. Duncan John McAfee, M.D., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When two attempts to remove a wounded man from a regimental aid post had failed owing to the stretcher-bearers being killed, he at once led forward a third party and succeeded in getting all the wounded back to a place of safety under very heavy shell fire. He showed splendid courage and self-sacrifice.

Temp. Capt. Frederick Buick McCarter, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When after an attack there were heavy casualties, he continued to attend the wounded in an open road enfiladed by machine-gun fire, and undoubtedly saved many lives.

Temp. Capt. James Allen Montgomery, M.D., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. On his own initiative he organized a line of stretcher-bearers to search "No Man's Land." He personally took charge of the party, and was often under heavy fire, and within a few feet of the enemy.

Temp. Capt. George Morris, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He moved his aid post forward and worked there ceaselessly day and night until the battalion was relieved. The aid post three times sustained direct hits from the enemy shell, but he immediately found another aid post and continued to dress the wounded under continual shell fire.

Temp. Capt. David Assur Henry Moss, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in working continually at his aid post during three days' operations under heavy shelling. Frequently shells dropped close by killing and wounding several men, but he remained at his work and showed the utmost indifference to danger.

Temp. Capt. Evan Edward Owens, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He carried on his work in a crowded aid post under continual shell fire with the greatest coolness and determination. Though blinded by gas, he continued for four hours to supervise the treatment of stretcher cases.

Capt. Harold Dobson Pickles, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of bearers. When a number of wounded were lying in a cellar and the adjoining building, in which a number of "P" bombs and S.A.A. were stored, was set on fire, he at once went to extinguish it and remove the ammunition While doing so he, a non-commissioned officer, and a man were wounded, but he got them both under cover. An hour later a second fire occurred, and he again went to extinguish it. For three days he worked without rest superintending the evacuation of the wounded.

Capt. John Alexander Pridham, Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty. He was in charge of an advanced dressing station where there were a large number of wounded when the enemy attacked. The task of removing them was an extremely difficult one, owing to the proximity of the enemy and heavy shell and machine-gun fire, but he carried it out sucessfully, remaining on the spot until all the wounded had been evacuated. By his courage and devotion to duty he was the means of saving many lives.

Capt. William Robertson, M.B., Royal Army Medical Corps.
For conspicious gallantry and devotion to duty in attending to the wounded in the open during an attack when the battalion was held up by heavy machine-gun and rifle fire, and several casualties occurred. When the two companies were cut off by heavy machine-gun fire and sustained casualties, he volunteered to try and reach them. His conduct throughout was most courageous.

Temp. Capt. Lionel Matthew Rowlette, D.S.O., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked untiringly attending to the wounded under very heavy fire throughout the day, and set a magnificent example of courage and coolness to all.

Temp. Capt. Cedric Russell, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked in the open attending to the wounded during an engagement, with complete disregard to danger under heavy shell fire.

Temp. Capt. Robert Rutherford, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked continuously day and night at his aid post under continual shell fire. When the aid post had twice sustained direct hits and he himself was suffering from severe concussion, he established a new aid post and remained at work under heavy fire.

Temp. Capt. Brian Herbert Swift, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When the front line was driven back close to the battery positions he moved about throughout the day from one battery to another wherever his services were needed, with utter disregard to danger under heavy fire. He remained

on the spot until the battalion had withdrawn, and was the last to leave the position. He set a splendid example of courage and determination.

Capt. Arthur Peregrine Thomson, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked untiringly and with utter disregard of danger, attending to the wounded under heavy fire for several days during an engagement. It was entirely due to his efforts and example that a large number of wounded were safely evacuated.

Capt. George Dibbs King Waldron, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of a party of bearers. Though several times blown over by bursting shells, he succeeded in evacuating all the wounded of the brigade. On one occasion he assisted to carry a stretcher case through a heavy barrage. He continued to work till utterly exhausted.

Capt. Douglas Larmer Wall, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He attended the wounded under heavy shell fire in most exposed positions. He showed great courage and determination.

Capt. James Anderson Young, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When the building in which a number of wounded were lying was heavily shelled, with the assistance of another man he succeeded in carrying all the wounded into a cellar, though shells were continually bursting in the building. He showed the greatest courage and determination.

Capt. James Carruthers Young, M.D., Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty when in charge of an advanced dressing station. When the village was continuously shelled he personally superintended the removal of many of the wounded to a safer position. During the night he had them all evacuated and established a new dressing station.

No. 32610 Serjt.-Major Frank Hulbert, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He showed complete disregard of danger while superintending the evacuation of the wounded. He worked continuously for seventy-two hours under heavy shell fire, and set a splendid example of pluck and initiative in removing the wounded from a barn which was being heavily shelled.

CANADIAN FORCE.

Capt. Edgar Douglas, Army Medical Corps.
For conspicuous gallantry and devotion to duty. He directed his relay of bearers under heavy shell fire, and though wounded, remained at duty until he was relieved.

Capt. Austin Dwight Irvine, Army Medical Corps.
For conspicuous gallantry and devotion to duty. During four days in the front line he worked day and night attending to the wounded, often under heavy shelling. When casualties occurred during an enemy barrage, without hesitation he left battalion headquarters and went to the assistance of the wounded.

Capt. Gordon Leigh Jepson, Army Medical Corps.
For conspicuous gallantry and devotion to duty. He established an aid post during an attack under heavy shell fire, and for over ten hours attended to the wounded in the open under enemy shelling. When the enemy shelled his position with gas shells, and a number of stretcher cases were lying outside the aid post, he went out at great personal risk and put box respirators on all the wounded, and by his prompt action saved many lives. He showed the greatest courage and self-sacrifice.

Capt. James Grant MacNeill, Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked unceasingly in the open attending to the wounded under heavy shell fire. During a gas shell bombardment he adjusted his own box respirator on a wounded serjeant, and obtained others for a number of stretcher cases, who were unable to help themselves. His coolness and courage were a splendid example to all, and undoubtedly saved many lives.

Capt. Wesley Herbert Secord, Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of the evacuation of the wounded from the forward area. During a heavy bombardment of gas and other shells he made a tour of the bearer posts to ensure that all anti-gas measures were being employed. He attended to wounded men in the open during the bombardment with complete disregard of danger. His coolness and courage were a splendid example to all.

Capt. William Ewing Sinclair, Army Medical Corps.
For conspicuous gallantry and devotion to duty. When in charge of bearers at the regimental aid post he worked for three days and nights attending to the wounded under heavy fire and in the face of great difficulties. Though suffering severely from the effects of gas he remained at duty and set a magnificent example of courage and coolness to all.

NEW ZEALAND FORCE.

Capt. Rex Carrington Brewster, F.R.C.S., Medical Corps.

For conspicuous gallantry and devotion to duty during an action. Throughout the day he was continually exposed to heavy shell fire while attending to the wounded, and set a splendid example to all ranks by his devotion to duty and contempt of danger.

War Office,
July 6, 1918.

The undermentioned Officers have been brought to the notice of the Secretary of State for War for valuable services rendered in connexion with the War :—

Capt. (Temp. Hon. Lieut.-Col.) D. J. Armour, Royal Army Medical Corps (Captain Royal Army Medical Corps, Special Reserve).

Col. W. H. Horrocks, C.B., M.B., Army Medical Service, retired pay.

Lieut.-Col. F. S. Irvine, D.S.O., M.B., Royal Army Medical Corps.

Temp. Major-Gen. Sir B. G. Moynihan, C.B.

Temp. Col. Sir R. Ross, K.C.B., F.R.S., F.R.C.S., Army Medical Service (Indian Medical Service, retired pay.)

Col. (Temp. Major-Gen.) Stanistreet, C.B., C.M.G., M.B., Army Medical Service.

Temp. Col. A. S. Woodwark, M.D., Army Medical Service.

War Office,
July 12, 1918.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign.

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE BELGIANS.

Croix de Guerre.

ROYAL ARMY MEDICAL CORPS.

Capt. Francis Dighton Annesley, Special Reserve.
Temp. Capt. Andrew Climie, M.B.
Temp. Capt. Roland Arthur Hertslet Fulton, M.B.
Lieut.-Col. Henry Charles Rupert Hime, D.S.O.
Temp. Capt. Gavin Dalzell McClean.
Capt. (Acting Lieut.-Col.) William Tyrrell, D.S.O., M.C., Special Reserve.
Capt. (Acting Lieut.-Col.) William Gordon Wright, D.S.O.
No. 57664 Pte. Maurice William Bell (Burton Stather, near Doncaster).
No. 339298 Staff-Serjt. Wilfred Brooke (Bradford).
No. 46806 Pte. John Henry Brownlee (North Shields).
No. 81627 Pte. (Acting Lance-Cpl.) James Bruce (Edinburgh).
No. 388088 Qmr.-Serjt. James Carney (Darlington).
No. 31005 Staff-Serjt. Alfred Frank Clarke (Bournemouth, E.)
No. 6218 Serjt. (Acting Staff-Serjt.) Alfred William Cockerell (Colchester).
No. 18200 Serjt. (Acting Qmr.-Serjt.) William George Collings (Portsmouth).
No. 301131 Cpl. Frederick William Christie Cooper (Aberdeen).
No. 439018 Staff-Serjt. (Acting Serjt-Major) James Creese (Bristol).
No. 305002 Staff-Serjt. (Temp. Serjt.-Major) Robert Duncan (Dundee).
No. 453510 Pte. John Dunning (Huddersfield).
No. 48826 Pte. Thomas Edwards (Treherbert).
No. 18678 Qmr.-Serjt. (Temp. Serjt.-Major) Lewis Spencer Ellis (Croydon, Surrey).
No. 457355 Lance-Serjt. George Edmund Essex (Exminster, nr. Exeter).
No. 3233 Pte. Martin Flannery (Ballina).
No. 38643 Qmr.-Serjt. (Acting Serjt.-Major) George Michael Fletcher (Sydenham).
No. 37751 Pte. Thomas Garvey (Leeds).
No. 30119 Serjt. Arthur Thomas Gay (Kennington, S.E.).
No. 48775 Pte. John Goodier (Sale).
No. 76654 Pte. Jack Goodwill (Bury).
No. 508024 Serjt. Bernard Percival Hale (Enfield Wash, N.).
No. 43 Pte. Alfred William Harding (Cirencester).
No. 39891 Pte. Hubert James Harding (Bolney).
No. 352256 Cpl. Leonard Holland (Burnley).
No. 446012 Serjt. Edward Honey, D.C.M. (Maidenhead).
No. 43471 Pte. John William Hooson (Leigh).
No. 39213 Serjt. James Ingram (Seaton Delavel).
No. 49467 Serjt. Rowland George Jackson, Cricklewood, N.W.).
No. 3529 Pte. James Jamieson (Glasgow).
No. 337577 Pte. William Charles Jones (Birkenhead).
No. 88583 Pte. George Kemp (Lavenham, Suffolk).
No. 417055 Serjt.-Major Albert Thomas King (Derby).
No. 46092 Pte. Stanley William Kirkham (Egremont, Cheshire).
No. 2009 Cpl. (Acting Serjt.) Herbert Latimer (Middlesborough).
No. 30160 Pte. John McCarthy (Dublin).
No. 1808 Serjt. Wm. John McClay (Woolwich).
No. 81023 Pte. Angus Isaac Mackay (Edinburgh).

No. 30437 Serjt.-Major John Mackenzie (Tayport).
No. 39854 Serjt.-Major Frederick Miller (Acton, W.).
No. 337090 Cpl. George Alexander Morton (Kirkdale).
No. 403203 Pte. Harold Newton (Leeds).
No. 350561 Pte. Grosvenor Nicholson (Manchester).
No. 5537 Pte. Ernest John Perkins (North Littleton).
No. 350007 Staff-Serjt. Thomas Kermode Quayle (Hyde, Lancashire).
No. 54520 Pte. William Rickaby (Kirby Moorside).
No. 354020 Serjt. (Acting Serjt.-Major) Edward Roberts (Manchester).
No. 11405 Qmr. Serjt. (Acting Serjt.-Major) William Scott (Brentford).
No. 563 Pte. (Acting Corporal) Charles Henry Stevens (Grimsby).
No. 31731 Serjt.-Major David Stewart (Glasgow).
No. 47091 Serjt. Walter Denison Strong (Hull).
No. 459314 Pte. Arthur William Lock Thomas (Torquay).
No. 512196 Serjt.-Major Harry Ernest Young (Brockley, S.E.).

CANADIAN FORCE ARMY MEDICAL CORPS.

Col. Arthur Edward Ross, C.M.G.
Major James Henry Wood.
No. 33343 Serjt. Thomas Fulthorpe.
No. 7251 Pte. Wm. Ernest May.
No. 2882 Pte. Gordon Stewart Noakes.
No. 241 Serjt. Wilfred Gordon Robinson.
No. 1566 Lance-Serjt. Bertram Robert Smith.
No. 17 Serjt. Eric David Wooster.

NEW ZEALAND FORCE MEDICAL CORPS.

Lieut.-Col. James Hardy Neil.
No. 3/210 Serjt. James Gardiner Jackson.
No. 3/172 Serjt. Frank Loftus.

INDIAN MEDICAL SERVICE.

Col. Courtenay Clarke Manifold, C.B., C.M.G., M.B.

War Office,
July 16, 1918.

His Majesty the King has been graciously pleased to approve of the award of a Second Bar to the Military Medal to the undermentioned Non-commissioned Officer :—

No. 53148 Pte. (Acting Serjt.) E. Broomhall, M.M., Royal Army Medical Corps (Henley). (M.M. gazetted October 21, 1916; First Bar gazetted January 22, 1917.)

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officers and Men :—

No. 534162 Cpl. J. A. Sellick, M.M., Royal Army Medical Corps (Woolwich). (M.M. gazetted December 21, 1916.)

No. 40842 Pte. (Acting Cpl.) P. McKeown, M.M., Royal Army Medical Corps (Barrow). (M.M. gazetted July 28, 1917.)

No. 1099 Cpl. (Acting Serjt.) A. Walton, M.M., Royal Army Medical Corps (S. Kensington). (M.M. gazetted August 21, 1917.)

No. 341771 Pte. T. R. Singleton, M.M., Royal Army Medical Corps (Carlisle). (M.M. gazetted January 14, 1918.)

No. 8992 Pte. (Acting Lance-Serjt.) W. McGee, M.M., Royal Army Medical Corps (South Shields). (M.M. gazetted June 14, 1918.)

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men :—

ROYAL ARMY MEDICAL CORPS.

No. 74870 Pte. F. J. Adams (Reading).
No. 58296 Cpl. F. Adlam (Salisbury).
No. 53894 Pte. A. C. Aplin (Kendal).
No. 69315 W. J. Arnold (St. Mary Cray).
No. 350097 Serjt. N. Ashworth (Bolton).
No. 89458 Pte. E. Ball (Corsham).
No. 352168 Pte. T. Bannister (Montreal).
No. 103964 Pte. J. Barnard (Walkden).
No. 63351 Pte. A. M. Bennett (Bradford).
No. 352105 Lance-Cpl. (Acting Cpl.) W. Boden (Burnley).
No. 417420 Pte. (Lance-Cpl.) J. H. Bott (Derby).
No. 339466 Pte. C. H. Bree (St. Heliers, Jersey).
No. 45539 Pte. J. T. Briggs (Tottenham).
No. 68676 Pte. J. Brooks (Ramsbottom).
No. 46007 Pte. H. Broster (Chester).
No. 368037 Pte. C. Caramaletis (Swansea).
No. 472019 Pte. H. V. Carrington (Luton).
No. 45561 Pte. E. H. Carter (Southall).
No. 341258 Serjt. P. Chesworth (St. Helens).
No. 88251 Pte. C. Chiffince (Battersea).
No. 350467 Pte. C. M. S. Clarke (Manchester).
No. 354034 Serjt. T. Coan (Manchester).
No. 350023 Serjt. J. Colecliffe (Manchester).
No. 36065 Pte. (Acting Cpl.) J. Crowther (Hartlepool).
No. 341529 Pte. J. Cuthbert (Liverpool).
No. 491186 Pte. B. Dakin (Leicester).
No. 344054 Staff-Serjt. J. Dale (Manchester).
No. 47173 Pte. E. Davis (Chichester).
No. 17663 Staff-Serjt. G. Duerden (Folkestone).
No. 459029 Pte. W. J. Elliott (Stonehouse).
No. 33046 Pte. A. E. Ellis (Islington, N.).
No. 1951 Pte. H. Gaiger (Wolverhampton).
No. 68631 Pte. J. L. Gaukroger (Halifax).
No. 35496 Pte. H. J. S. Gibbs (Highgate).

No. 20575 Pte. (Acting Cpl.) F. A. Gregory (Canterbury).
No. 62865 Pte. (Acting Serjt.) A. J. Guerins (Limerick).
No. 350022 Serjt. A. Hamilton (Cheetham).
No. 7301 Pte. D. S. Harris (Kennington Park).
No. 66541 Pte. T. Harris (Wadeford).
No. 31242 Pte. W. H. Harris (Lincoln).
No. 56708 Cpl. J. D. Hart (Stone).
No. 101193 Pte. J. W. Hickenbotham (Derby).
No. 352256 Cpl. L. Holland (Burnley).
No. 60316 Serjt. (Acting Staff-Serjt.) F. W. J. Hooper (Shrewsbury).
No. 369257 Pte. R. H. Hopkins (Newport, Mon.).
No. 40036 Serjt. W. H. Horn (Wimbledon).
No. 305016 Serjt. M. Hunter (Dundee).
No. 22712 Staff-Serjt. W. Hutchinson (Larne).
No. 450147 Pte. S. A. Jenkinson (Manchester).
No. 403490 Cpl. W. Jennings (Shipley).
No. 69457 Pte. J. Layton (Leeds).
No. 45908 Serjt. (Acting Staff-Serjt.) A. Linton (Lochgelly).
No. 45258 Pte. W. Loughton (Wheatley Hill).
No. 421252 Pte. J. Lowe (Wolverhampton).
No. 56870 Pte. A. Lutzes (Commercial Street, E.).
No. 358270 Pte. G. MacDonald (Burnley).
No. 90136 Serjt. J. McKenzie (Dundee).
No. 536047 Pte. F. C. Neale (Greenwich).
No. 19533 Cpl. (Acting Serjt.) E. P. Newman (Tottenham, N.).
No. 31862 Pte. P. J. O'Neill (Dublin).
No. 5695 Pte. (Acting Serjt.) F. Phillips (Taunton).
No. 46537 Pte. (Acting Cpl.) D. Pratt (Lochore, Fifeshire).
No. 55919 Pte. E. Price (Farnworth).
No. 36280 Pte. W. W. Richardson (Dumfries).
No. 417360 Pte. E. Roberts (Long Sutton).
No. 11902 Pte. T. Shenton (Hanley, Staffs).
No. 45646 Pte. (Acting Serjt.) W. W. Smith (Kineton).
No. 14764 Pte. (Acting Serjt.) T. C. Stanley (Failsworth).
No. 352171 Cpl. J. E. Street (Bradford).
No. 364395 Pte. A. Tanner (Coedkernen, Mon.).
No. 2142 Cpl. (Acting Serjt.) E. C. Taylor (Brixton).
No. 51002 Pte. E. Viggars (Stoke-on-Trent).
No. 73724 Pte. S. Walker (Northowram).
No. 554034 Pte. G. H. White (Canning Town).
No. 47632 Pte. H. E. Winter (Battersea).
No. 92581 Pte. B. Wright (Halifax).
No. 16820 Pte. W. Yea (Bournemouth).

War Office,
July 18, 1918.

With reference to the awards conferred as announced in the *London Gazette*, dated February 18, 1918, the following are the statements of service for which the decorations were conferred:—

AWARDED THE SECOND BAR TO THE MILITARY CROSS.

Temp. Capt. Archibald Fullerton, M.C., M.D., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked untiringly under heavy shell and machine-gun fire, attending to the wounded of his own and other units. His fearless conduct undoubtedly saved many lives.

AWARDED A BAR TO THE MILITARY CROSS.

Temp. Capt. William Fotheringham, M.C., M.B., Royal Army Medical Corps (Special Reserve).
For conspicuous gallantry and devotion to duty. He attended to the wounded in an exposed position under heavy hostile gas shell fire. Though suffering badly from gas he continued at work with the greatest courage and determination until he was blinded by gas.

Temp. Capt. William John Knight, M.C., M.D., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked continuously during an engagement attending to the wounded under heavy fire, and later went into a village which was being heavily shelled, and brought away several wounded men. He went back to the front line after the position had been evacuated, and brought back several badly wounded men. He worked with untiring energy throughout the operations, and saved many lives.

Capt. Thomas Ainsworth Townsend, M.C., Royal Army Medical Corps.
For most conspicuous gallantry and devotion to duty. Although twice wounded he refused to have his wound attended to, and continued to dress the wounded under a continuous and heavy concentration of high-explosive and gas shells. Not only did he attend the wounded and gassed of his own unit, but rendered aid, under conditions of great difficulty, to wounded of neighbouring battalions, whose medical officers had become casualties. His complete disregard of personal danger and splendid devotion were a magnificent example to all.

Capt. Frederick William Lees, M.C., Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked untiringly attending to the wounded and superintending their evacuation. Though his aid post was continually under heavy shell fire he carried out his work with an energy and cheerfulness which were a splendid example to all. He saved many lives by his devotion to duty.

AWARDED THE MILITARY CROSS.

Temp. Capt. Eric Phillip Blashki, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He went forward during an engagement and established a dressing station in an advanced position. He remained at his post under

heavy shelling and collected the wounded from an area swept by machine-gun fire. He showed the greatest courage and resource.

Capt. Frank Chadwick, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. After the troops had been withdrawn he remained with the wounded all night in an advanced position, and organized their removal in the face of great difficulties. By his courage and determination he succeeded in getting all the wounded away.

Temp. Capt. Thomas Maitland Crawford, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He was wounded and rendered temporarily unconscious by a shell which mortally wounded the colonel and adjutant of his battalion. As soon as he recovered he attended to their wounded, and remained on the spot without having his own wounds dressed until stretcher-bearers arrived. He reported to brigade headquaaters before having his wounds attended to, and showed splendid courage and self-sacrifice.

Temp. Capt. William Claughton Douglas, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. While returning from the regimental aid posts he came under a heavy barrage, and was slightly wounded. Seeing that some men further back had been wounded he at once went to their assistance, got them under the only available cover, attended to their wounds, and organized stretcher parties for their removal. His prompt and gallant action saved the lives of two seriously wounded men.

Temp. Lieut. Frederick Barnes Elwood, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked with the greatest coolness and energy throughout two days' operations, attending to the wounded in his aid post close to the firing line. Later, he went out with his stretcher-bearers, and brought back many wounded who were lying out in "No Man's Land."

Capt. Archibald McLaren Ferris, M.B., Royal Army Medical Corps (Special Reserve).
For conspicuous gallantry and devotion to duty. He continually exposed himself to heavy fire in attending to the wounded during an attack. Later, when an officer was wounded and was lying out in an exposed position, he crawled out and brought him in over ground swept by the enemy's fire. His gallantry and courage undoubtedly saved many lives.

4th Class Assistant Surg. James Garnett Goodman, I.S.M.D.
For conspicuous gallantry and devotion to duty. He remained tending the wounded under heavy fire, until every case had been evacuated, after which he followed the battery into action. On the previous day seeing the battery come under an intense shell fire he at once went up to the guns to render assistance. His coolness, initiative and keenness were most marked.

Temp. Capt. James Huntley Legge, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in an enemy counter-attack which almost succeeded in penetrating to his aid post. With the greatest coolness and courage he continued his work of clearing the wounded, not only of his own battalion, but of other units. Throughout the hostile fire was intense, and it was due to his untiring efforts that so many wounded were quickly and efficiently evacuated.

Capt. Reginald Devereux Moore, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked continuously for eight days attending to the wounded at an advanced dressing station often under shell fire. His organization of the work was excellent, and by his courage and cheerfulness he inspired all ranks with confidence which assisted them materially in the performance of their duties.

Capt. John Gilbert Morgan, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When the advanced dressing station had been ordered to withdraw he went forward with a party of bearers and successfully cleared a number of wounded from the regimental aid posts. The operation was carried out under continuous shell and machine-gun fire.

Temp. Capt. John Oscar Thomas, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He dressed a wounded officer and man under heavy fire and got them to a place of safety. He showed great coolness and courage.

Temp. Capt. Philip Hewer Wells, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He attended to the wounded of several units who were lying in an exposed position under fire. He worked throughout the night, often under an intense bombardment of gas and H. E. shells, and by his courage and self-sacrifice saved many lives.

Temp. Capt. Ernest William Gilmore Young, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He collected and dressed the wounded in an exposed position under heavy fire, and remained on the spot after the withdrawal of the regiment until all the wounded had been brought in.

Capt. Gavin Young, M.B., Royal Army Medical Corps (Special Reserve).
For conspicuous gallantry and devotion to duty in attending to the wounded under heavy machine-gun fire. He worked up to the leading wave and searched the whole ground for wounded

under continuous fire, and, owing to his exertions, all the wounded were evacuated with great rapidity. Later he showed great courage and devotion to duty in rescuing wounded from destroyed dug-outs under shell fire.

Capt. George May Foster, Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in charge of the evacuation of the wounded from the front line during the operations, and set a splendid example to his stretcher-bearers by his courage and determination. He led a party to remove several stretcher cases under heavy shell fire, and though wounded himself he attended to their wounds and arranged for their removal.

Capt. Alfred Stannage Porter, Army Medical Corps.

For conspicuous gallantry and devotion to duty. He dressed many wounded during the operations, working in the open under intense fire, and set a splendid example of courage and self-sacrifice.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
July 27, 1918.

The King has been graciously pleased to give directions for the following appointments to the Most Distinguished Order of Saint Michael and Saint George, for services rendered in connexion with Military Operations in East Africa. Dated June 3, 1918 :—

To be additional members of the Third Class, or Companions, of the said Most Distinguished Order :—

Col. Gerard William Tate, D.S.O., M.B., Army Medical Service.

Lieut.-Col. Reginald George Turner, D.S.O., F.R.C.S., Indian Medical Service.

War Office,
July 27, 1918.

His Majesty the King has been graciously pleased to approve of the undermentioned Rewards for Distinguished Service in connexion with Military Operations in East Africa. Dated June 3, 1918 :—

TO BE BREVET LIEUTENANT-COLONEL.

(On Retired List, Reserve of Officers, Special Reserve, New Army, of Territorial Force, in the case of officers belonging to these categories, as applicable.)

Major (Temp. Lieut.-Col.) W. Benson, D.S.O., M.B., Royal Army Medical Corps.

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Lieut.-Col. Arthur Charles Adderley, Royal Army Medical Corps.

Temp. Major (Acting Lieut.-Col.) Thomas Malcolm Russell Leonard, Special List, West African Medical Service, West African Field Force.

South African Forces.

Capt. (Acting Major) Alexander McWatt Green, South African Medical Corps.

Lieut.-Col. Temple Smyth, South African Medical Corps.

AWARDED THE MILITARY CROSS.

Capt. Frank Montague Barnes, M.R.C.S., L.R.C.P., Royal Army Medical Corps (Special Reserve).

Capt. Henry Drummond Brown, M.B., Royal Army Medical Corps (Special Reserve).

Lieut. Norman Stewart Bruce, Royal Army Medical Corps (Special Reserve).

Temp. Lieut. Gilbert Burnet, M.B., Royal Army Medical Corps.

Capt. Harold Armstrong Crouch, M.R.C.S., L.R.C.P., Royal Army Medical Corps (Special Reserve).

Temp. Capt. Mark Clayson Gardner, M.B., Royal Army Medical Corps.

Temp. Capt. Ernest Gibson, Special List, West African Medical Service, attd. Nigeria Rifles, West African Field Force.

Capt. James Burne Papsley, M.B., F.R.C.P., Indian Medical Service, attd. C.F.A.

Capt. George Smith Lawrence, M.B., Royal Army Medical Corps (Special Reserve).

Temp. Capt. Thomas Hunter Massey, East African Medical Service, attd. King's African Rifles.

Temp. Capt. Henry Ruddock Morehead, Special List, West African Medical Service, attd. Nigeria Rifles, West African Field Force.

Temp. Capt. Thomas Robert Sandeman, M.B., F.R.C.S., Special List, West African Medical Service, attd. Nigeria Rifles, West African Field Force.

Capt. Ralph Roylance Scott, Royal Army Medical Corps (Special Reserve).

Temp. Capt. Christopher James Wilson, East African Medical Service, attd. King's African Rifles.

Temp. Capt. William Hall Watson, South African Medical Corps.

War Office,
July 25, 1918.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign.

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATION CONFERRED BY HIS MAJESTY THE KING OF THE BELGIANS.

Ordre de la Couronne.

Chevalier.

Temp. Capt. Adrian Stokes, D.S.O., M.D., F.R.C.S.I., Royal Army Medical Corps.

ROYAL ARMY MEDICAL CORPS PRISONERS OF WAR FUND.

(OFFICIAL CARE COMMITTEE RECOGNIZED BY THE WAR OFFICE FOR THE ROYAL ARMY MEDICAL CORPS.)

THE following is the third list of contributions by units at home and abroad to our Prisoners of War Fund, and the Hon. Secretary begs to express his regret at the delay in issuing it. The list only contains the amounts received up to the middle of May, and it is hoped that a further instalment may be published at an early date.

The number of subscribers and the work connected with the Fund has greatly increased in the last few months owing to the large increase in the number of our prisoners. All the contributors may rest assured that, thanks to the Ladies' Committee, the supply of parcels has never run short, and they are distributed with the greatest regularity to the men in captivity, principally in Germany.

The price of parcels has, like all other commodities, considerably increased, and each cost 10s., so it is hoped that the generous donations of units and other friends may be maintained at their present satisfactory level.

LIST OF COMPANIES AND UNITS AT HOME AND ABROAD,

CONTRIBUTIONS TO PRISONERS OF WAR FUND IN 1918.

May 1.

No. 6 Sanitary Section	£1	15	2.
Advance Depot Medical Stores, No. 12	1	5	9
2/3rd City of London Field Ambulance	5	2	8
8th Training Battalion, Blackpool	5	0	0
133rd Field Ambulance	9	4	2
35th Company R.A.M.C., Millbank	10	0	0
100th Field Ambulance (4 cheques)	15	12	6
No. 2 Casualty Clearing Station	12	0	0
30th Motor Ambulance Convoy	11	0	0
38th Casualty Clearing Station..	33	9	2
112th Field Ambulance	14	13	4
107th Field Ambulance	2	0	0
76th Field Ambulance	15	0	0
9th General Hospital ..500 fr.			
74th Field Ambulance	5	17	8
No. 1 Casualty Clearing Station	15	0	0
46th Field Ambulance	10	13	1
No. 39 Casualty Clearing Station	6	0	0
72nd Field Ambulance ..600 fr.			
73rd Field Ambulance ..190 fr.	7	0	0
Stationary Hospital, Abancourt	8	9	0
106th Field Ambulance	5	0	0
7th Training Battalion, Blackpool	9	18	8
7th Stationary Hospital ..	6	0	0
7th Casualty Clearing Station ..	£22	0	0
10th Casualty Clearing Station	25	13	9
17th Casualty Clearing Station	10	0	0
Queen Mary's Hospital, Whalley	50	0	0
62nd General Hospital	31	14	7
96th Field Ambulance	9	13	6
24th Field Ambulance	40	0	9
3/2nd Lancs. Field Ambulance..	16	10	0
15th Casualty Clearing Station	2	7	8
No. 19th Company, Chester ..	30	0	0
3rd Cavalry Field Ambulance ..	25	0	0
99th Field Ambulance	10	0	0
23rd Casualty Clearing Station	50	0	0
Military Convalescent Hospital, Holywood	8	0	0
H Company Territorial Force Depot, Blackpool	34	10	0
7th Company R.A.M.C., Devonport	30	0	0
6th General Hospital (Officers' Mess)	5	0	0
No. 11 General Hospital, A Section	14	0	0
15th Motor Ambulance Convoy (Concert)	30	0	0
60th Field Ambulance	7	15	0
No. 83 General Hospital ..	12	0	0
No. 50 General Hospital ..	20	0	0

R.A.M.C. Detachment, Cairo ..	£7	0	0
No. 7 Field Ambulance.. ..	5	0	0
No. 21 Casualty Clearing Station	10	0	0
34th Field Ambulance Officers, N.C.O.'s and Men	20	6	8
R.A.M.C., Netley	25	0	0
39th Ambulance Train	5	15	2
R.A.M.C., Dieppe and Le Treport	96	14	0
R.A.M.C., Dieppe and Le Treport .. .. (7113·75 fr.)			
No. 4 General Hospital.. ..	15	0	0
44th Casualty Clearing Station..	7	4	10
3rd North Midland Field Ambulance	2	10	0
Detachment R.A.M.C., Admiralty Pier, Dover	20	0	0
2/2nd North Midland Field Ambulance	24	4	6
O.C. Detachment, R.A.M.C. and Nursing Staff, Wareham ..	3	5	6
Detachment R. A. M. C. Rest Camp, Southampton	4	10	0
No. 2 General Hospital, France	19	11	9
111th Field Ambulance (Officers)	7	0	0
Military Hospital, Tidworth (Officers)	25	0	0
17th Advance Depot Army Medical Stores	1	0	0
No. 1 Field Ambulance	10	0	0
28th Company R.A.M.C., Gibraltar	4	4	0
42nd Stationary Hospital ..	9	11	3
42nd Stationary Hospital, Serjeants' Mess	3	0	6
54th Field Ambulance (Officers)	8	0	0
36th Field Ambulance	£30	0	0
74th General Hospital Officers' and Serjeants' Mess	29	0	0
Malta Serjeants' Mess, Cottonera	0	15	0
Malta Detachment R.A.M.C. ..	1	1	0
2/3rd South Midland Field Ambulance	2	2	0
50th Stationary Hospital, Colchester	1	2	6
Detachment R.A.M.C. Bovington Camp and 18th Battalion Tank Corps	10	16	0
113th Field Ambulance	6	18	0
Officers' Mess, R.A.M.C., Cosham	5	5	0
142nd Field Ambulance	18	0	0
11th Sanitary Section and Sanitary Squads	3	7	6
141st Field Ambulance	3	13	4
11th General Hospital, I.E.F. ..	12	5	0
37th Motor Ambulance Convoy..	17	7	0
1st Western General Hospital, T.F.	54	0	9
Valletta Military Hospital, Malta	6	0	0
Cape Coloured Labour Battalion Hospital..	2	12	0
14 Medical Officers of No. 8 General Hospital	14	0	0
64th Field Ambulance (Officers)	5	0	0
57th Casualty Clearing Station..	13	18	8
75th General Hospital	1	12	0
75th General Hospital .. 486 fr.			
A.D.M.S., —th Division ..	6	9	4
Fort Manoel Military Hospital, Malta	23	13	0
23rd Field Ambulance	22	0	0

BIRTH.

CHOPPING.—On August 4, at 1, Devonshire Gardens, Glasgow, the wife of Lieut.-Colonel A. Chopping, C.M.G., R.A.M.C., a daughter.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written; but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed: The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 324, Adastral House, Victoria Embankment, E.C. 4.

Communications have been received from Col. R. H. Firth; Major R. C. Wilmot; Capts. J. T. Grant, C. M. Finny, C. T. W. Hirsch, J. J. Healy; A. Bacot, Esq.

The following publications have been received:—

British: The Medical Press and Circular, The Hospital, The Practitioner, St. Bartholomew's Hospital Journal, The Royal Engineers' Journal, Bulletin of the Canadian Army Medical Corps, Veterinary Review, The Indian Journal of Medical Research, Agricultural Research Institute (Pusa), Guy's Hospital Gazette, The Indian Medical Gazette, The Medical Journal of Australia, The Medical Journal of South Africa, The Journal of Tropical Medicine and Hygiene, The British Journal of Surgery, The Journal of State Medicine, Butterworth's Medical Catalogue, 1918, *Edinburgh Medical Journal.*

Foreign: Bulletin de l'Institut Pasteur, The Military Surgeon, War Medicine, Surgery and Hygiene, L'Ospedale Maggiore, Archives Médicales Belges, Annali di Medicina Navale e Coloniale, Revista de Veterinaria e Zootechnia.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

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The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," 25, Adastral House, Victoria Embankment, E.C. 4, and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

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